OCT 4 1950

LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS

ALBACORE FISHING GROUNDS DEVELOPMENT IN 1939

SPECIAL SCIENTIFIC REPORT: FISHERIES No. 33

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

United States Department of the Interior
Oscar L. Chapman, Secretary
Fish and Wildlife Service
Albert M. Day, Director

Special Scientific Report - Fisheries
No. 33

Results of Encouragement for the Development of Albacore Fishing Grounds in 1939 1/

Translated from the Japanese language by

W. G. Van Campen
Pacific Oceanic Fishery Investigations

CONTENTS

Page

I. The Purpose of Encouraging the Development of Albacore Fishing Grounds.. 1

II. Items Concerned in the Plans for Carrying Out the Program of Encouragement 1

1. Outline of the albacore fishing grounds development conference 1
Participants - Speech by the Chief of the Fisheries Bureau - Concerning the handling of subsidy funds for the encouragement of albacore fishing ground development - Matters concerning the development program discussed by the Conference

Figure 1 Areas for the development of albacore fishing grounds.

2. Vessel personnel and the operation of private radio-telephone facilities 8

III. Conditions Under Which the Operations Were Carried Out 8

1. Outline of the execution of operations 8
[Tables]

Table 1 Participating prefectures and vessels employed
Table 2 Vessel personnel
Table 3 Fishing gear used

Figure 2 Operating days and fishing days for each cruise of each vessel

2. Outline of results of operations..... 9
[Tables and figures]

1/ Published February 1940 by the Fisheries Bureau of the Ministry of Agriculture and Forestry - Confidential

Page

Table 4 Summary of results of operations
Table 5 Results of operations by voyages
Table 6 Report of results by voyages for each vessel

Figure 3 Track charts
Shiratori Maru, Miyagi Maru, Aomori Maru, Fusa Maru, Akita Maru, Iwate Maru, Sagami Maru, Kamoi Maru, Musashi Maru

3. Results of operations by participating vessels of each prefecture.47

Report of results of development of albacore grounds
" Aichi Prefecture 47
" Miyagi Prefecture 99
" Aomori Prefecture 117
" Chiba Prefecture 121
" Akita Prefecture 125
" Iwate Prefecture 129
" Kanagawa Prefecture 133
" Mie Prefecture 136
" Tokyo District 148

4. Particulars..... 149

(a) Outline of the distribution of water temperatures and chlorinities
[Figures and tables]

Figure 4 (6 sheets) Monthly Isotherms and Isochlors in the operating areas
Figure 5 Albacore catch density in the operating areas
Table 7 Relation between albacore catch and the vertical distribution of water temperatures by areas and by months

(A) Where albacore were taken
(B) Where no albacore were taken

(b) Water temperatures and catch rates
[Tables]

Table 8 Correlation of albacore catch rates and surface temperatures
Table 9 Correlation of albacore catch rates and temperatures at the 50-meter level
Table 10 Correlation of albacore catch rates and temperatures at the 100-meter level

[Appended references]

(1) Budget of subsidy funds for encouraging the development of albacore fishing grounds
(2) Table of sums designated to be paid as subsidies for the encouragement of the development of albacore fishing grounds

I. The Purpose of Encouraging the Development of Albacore Fishing Grounds

In the last fiscal year grants in aid were made to the ten prefectures and one metropolitan district of Tōkyō, Akita, Aomori, Iwate, Miyagi, Fukushima, Chiba, Kanagawa, Shizuoka, Aichi, and Mie with the object of stimulating the export trade and stabilizing the economic position of the fishermen by increasing the production of albacore, one of our nation's most important marine products. These prefectures used their deepsea fishery patrol vessels to carry out operations to develop albacore fishing grounds with these subsidies. As a result good fishing grounds were discovered in the North Central Pacific area, however, it was recognized that continuing detailed surveys would be required in order to induce ordinary fishing vessels to exploit these grounds. Consequently these operations were again subsidized in this fiscal year and as a result the true value of these fishing grounds has been made clear.

II. Items Concerning the Plans for Carrying Out the Program of Encouragement

1. Outline of the Albacore Fishing Grounds Development Conference.

In continuation of the previous year's program, inquiries were made of those prefectures which are most deeply concerned with the albacore fishery to ascertain whether or not they were interested in carrying on operations to develop the albacore fishing grounds. As the eight prefectures and one metropolitan district of Tōkyō, Aichi, Miyagi, Aomori, Chiba, Akita, Iwate, Kanagawa, and Mie expressed an interest in such a project, a conference of cognizant officials from these prefectures was held at the Ministry of Agriculture and Forestry on March 13, 1939. The Chief of the Fisheries Bureau gave a talk on the development of the albacore fishing grounds, and the conditions for the granting of subsidies for this work were presented. In addition discussions were held concerning various concrete matters related to the development of fishing grounds. The persons attending the conference, the speech by the Chief of the Bureau, the conditions for the granting of subsidies, and the matters conferred upon were as follows:

Persons Attending the Conference

Fisheries Bureau Officials	
Chief of the Fisheries Bureau	Nagashige Tanaka
Chief of the Section of Oceanography	Eizaburō Tachibana
Technician	Yōkichi Kurita
Technician	Junichi Iohara
Technician	Isaku Takehisa
Technician	Saburō Takashima
Clerk	Shōzō Iijima
Assistant Technician	Sohei Fukai
Assistant Technician	Junzaburō Yamada
Officials of the Fisheries Experiment Station	
Technician	Hisatoshi Marukawa
Assistant Technician	Morisaburō Sakai

Officials of the Prefectural Fisheries Experiment Stations

Tōkyo	Chief, Ōshima Branch Station	Kenzaburō Hayashi
Kanagawa	Chief of the Station	Mantao Sengawa
Chiba	Chief, Katsuura Branch Station	Shichirō Kawahara
Mie		Yoshio Honda
Aichi	Chief of the Station	Kazukatsu Komatsu
Iwate	Chief of the Station	Eikichi Koinuma
Aomori	Chief of the Station	Nobumasa Odō
Akita	Chief of the Station	Mikinosuke Ōmura

Speech by the Chief of the Fisheries Bureau

There is hardly any further necessity to say that the greatest duty which has been given those of us who are concerned with fisheries production is to produce an abundance of food for our countrymen and to contribute to the improvement of our international trade balance by developing marine resources and increasing the supply of fisheries products. We feel the gravity of this responsibility particularly today because of the effects of the Incident.

Operations to develop the albacore fishing grounds were carried out last year, but in view of the fact that the development of these grounds has an extremely important meaning in regard to the matters just mentioned, we are going to carry on similar operations again this year.

Last year was the first time we had engaged in such a project, but thanks to the cooperation of all concerned we were able to discover the existence of promising new fishing grounds in the general area in which we had expected to find them. I am sure that you have all made studies from various angles of your last year's experiences and that you will bring full self-confidence to the planning of this year's operations. I expect, therefore, that this year we will be several times as successful as we were last year. I hope that you will in your task of supervising and encouraging the personnel engaged in these operations redouble your efforts of last year so that we may attain the anticipated results in the development of these fishing grounds.

Here in the Bureau we have been making detailed studies of the results obtained by the various vessels which took part in last year's operations. As a result we have thought it appropriate to shift the area of operations slightly to the northwest this year to the area located between 163° E and 165° W and between 30° and 45° N. On this point, however, as well as on other aspects of this year's operating plans, we hope sincerely that you will all express your opinions frankly so that the plans may be perfected and the success of the venture enhanced.

Matters Concerning the Granting of Subsidies for the Development of Albacore Grounds

1. The subsidy funds are to be granted to defray the following expenses of fishing vessels which participate in the development of albacore fishing grounds in the North Central Pacific during the period from May 1 to October 31, 1939, in accordance with a plan deemed suitable by the Minister of

Agriculture and Forestry, provided, however, that the application of such funds to the expenses listed under item (1) shall not exceed two-thirds of such expenses, and that the funds supplied to defray the expenses listed under items (2) to (4) shall not exceed the actual expenses incurred.

(1) Expenses for fishing gear, pay and food for crews, expenses for expendable items in the engine and deck departments, expenses for expendable items used in fishing, expenses for expendable items used in radio-telephone and refrigeration machinery, expenses for ship repairs, insurance charges, miscellaneous expenses

(2) Pay of supervisory personnel

(3) Expenses of reporting on the fishing situation by radio-telephone

(4) Various forms used for reports

2. Applicants for funds shall address their applications to the Minister of Agriculture and Forestry accompanied by itemized statements prepared in accordance with the appended Form No. 1. These applications and statements shall be presented in duplicate.

3. The Minister of Agriculture and Forestry shall receive such applications and for those which he approves he shall furnish to the applicant a written order for the granting of albacore fishing ground development subsidy funds.

4. When applicants who have received orders for grants of subsidy funds intend to make important changes in the operating period, operating area, vessel, engines, processing machinery, and storage facilities listed in their itemized statements of operations, they shall request the approval of the Minister of Agriculture and Forestry.

5. Applicants who have received orders for grants of subsidy funds shall report to the Minister without delay the beginning and completion of their operations.

6. When approved applicants have completed their period of operations, they shall forward to the Minister a request for subsidy funds accompanied by logs of operations and a detailed account of income and expenditures. This account must be supplied in duplicate.

7. Approved applicants shall present a report of results prepared in accordance with the appended Form No. 2. The Minister may require the submission of other documents as he sees fit.

8. In case an approved applicant fails to follow the orders of the Minister of Agriculture and Forestry or in case the number of days of operation does not equal three-fourths of the operating period, the grant of funds may be revoked or a part of the subsidy may be withheld, however, days spent in taking refuge from dangers, in taking on wood, water, provisions, and bait, in landing the catch, and in repairing fishing gear, as well as the number of days spent in transit or at anchor as deemed necessary by the Minister will be regarded as days of operation.

Form No. 1

Itemized Statement of Operations

[The details of the form have been omitted.]

Form for Budget of Income and Expenditures

(The detailed account of income and expenditures is also to follow this form)

[The details of this form have been omitted.]

Form No. 2

Report of the Results of Development of Albacore Grounds

(A) Report to be sent by radio from vessels on the fishing grounds

Items and order in which they are to be transmitted

1. Date of operation
2. Position of fishing ground
3. Surface temperature on the fishing ground
4. Catch by number of each species
5. Course on which the vessel is proceeding

(B) Report to be submitted at the conclusion of each cruise

(see appended form)

[This form has been omitted from the translation.]

(C) Report to be Submitted at the Conclusion of the Operating Period

[This form has been omitted from the translation.]

Matters Conferred Upon With Regard to the Development of the Albacore Fishing Grounds

1. Matters concerning methods of operation

(a) Fishing gear employed to be longlines, pole and line, and trolling lines, with longlines as the principal gear.

(b) Investigation of the fishing situation and the oceanographic conditions on the fishing grounds to follow the methods used hitherto in "Coordinated Tuna Fishery Investigations".

2. Matters concerning areas of operation

Operating areas will be as shown in Appendix A. That portion of the area which lies east of 175° west longitude is Area 1, the portion west of 175° west longitude and east of 175° east longitude is Area 2, and that which lies west of 175° east longitude is Area 3. Assignment of areas will be as follows:

[See next page]

3. Matters concerning the period of operations

The period of operations for all vessels will be from May 1 to October 31. Vessels operating in Areas 1 and 2 will each make three cruises

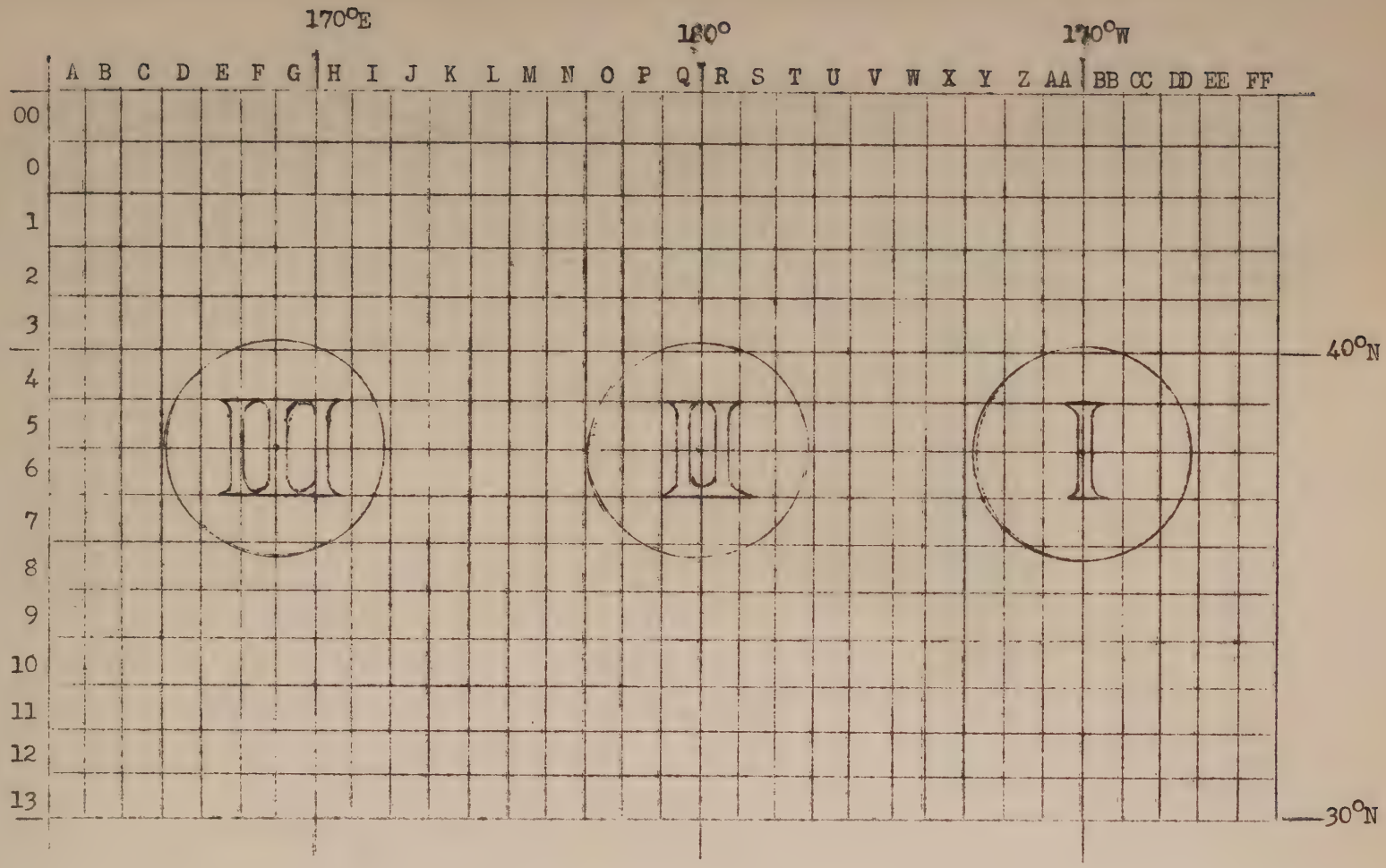


Fig. 1 Survey Areas for the Development of Albacore Fishing Grounds

LIBRARY
FISH & WILDLIFE SERVICE

Area Assignments of Participating Vessels

Area	Prefecture	Vessel	Gross Tonnage	Horsepower
Area 1	Aichi	Shiratori Maru	269.78	450
"	Miyagi	Miyagi Maru	248.22	400
"	Aomori	Aomori Maru	185.88	320
Area 2	Chiba	Fusa Maru	176.60	320
"	Iwate	Iwate Maru	158.42	250
"	Akita	Akita Maru	139.49	250
Area 3	Kanagawa	Sagami Maru	136.00	250
"	Mie	Kamui Maru	138.30	275
"	Tokyo	Musashi Maru	104.54	250

and vessels operating in Area 3 will make four cruises each.

4. Matters concerning communicating methods

(a) A detailed division of the operating areas will be made as shown in Appendix A and the symbols supplied for the coordinates will be used to simplify communications.

(b) Liaison between the participating vessels and the Fisheries Bureau or the Fisheries Experiment Station will insofar as possible be maintained through the fisheries experiment station to which the vessel is attached.

(c) When a participating vessel leaves port or returns to port it will speedily inform the Chief of the Fisheries Bureau, the Chief of the Fisheries Experiment Station, and all prefectural fisheries experiment stations which have patrol vessels engaged in the operation.

5. Matters concerning reports of results

(a) Concerning daily fishing situation reports

When operations on the fishing grounds have been begun, the following items will be speedily reported daily by radio via the cognizant prefectural fisheries experiment station to the Chief of the Fisheries Bureau and the Chief of the Fisheries Experiment Station.

(1) Items to be reported

Date of operation
Position of fishing ground
Surface water temperature on the fishing ground
Number of fish taken by species
Course on which the vessel is proceeding (or about to proceed)

(2) The dispatch will be in the following order and with the symbols indicated

[Details of communications procedure have been omitted from the translation.]

(b) Matters concerning the reports of the fishing situation and oceanographical conditions for each cruise

At the conclusion of each cruise a report in the form shown in Appendix B, together with a chart of the vessel's track, will be forwarded to the Chief of the Fisheries Bureau and the Chief of the Fisheries Experimental Station.

(c) Matters concerning the reports to be submitted at the end of the operating period

At the end of the operating period a report on the items shown in Appendix C will be prepared and forwarded together with a log of the operations to the Minister of Agriculture and Forestry.

(d) Unofficial publication of information on the fishing situation and the results of the operations will be made only after consultation with the Chief of the Fisheries Bureau.

2. Vessel Personnel and the Operation of Private Radio-telephone Facilities

(A) Concerning officers of the vessels

With regard to the ratings of officers of the vessels operating in Areas 1 and 2 in the albacore fishing grounds development program, they should conform to Operating Limitations Type 3-A, but in case it is difficult to get officers with this rating permission is given to lower the requirements as provided in Sections 18 and 19 of the Regulations for the Administration of the Emergency Shipping Control Law.

(Reference)

Ministry of Communications Directive No. 1341

[The text of this directive has been omitted from the translations.]

(B) Concerning the Operation of Private Radio-telephone Facilities

In order to attain the objectives of this operation it is necessary that the vessels operating in each area keep a close liaison concerning the fishing situation, oceanographic conditions, and the positions and movements of the vessels. Therefore, negotiations having been made with the Ministry of Communications to permit these communications, vessels are to request and obtain the permission of the Chief of the Communications Station having jurisdiction over them to make changes in the employment of their facilities as provided in Section 5 of the Private Radio-telephone Regulations.

III. Conditions Under Which the Operations Were Carried Out

(1) Outline of the Execution of the Operations

This year's operations were participated in by one metropolitan district and eight prefectures, and nine large patrol vessels of several hundred tons gross tonnage were employed. Table 1 shows the areas of operation and the names of the vessels, while Table 2 shows the supervisory personnel and the crews of the vessels.

As shown on Chart 2, the first vessel to begin operations was the Chiba Prefecture patrol vessel Fusa Maru, which sailed from Katsuura on May 10 and began fishing May 21. It was followed by the Musashi Maru from Tokyo, the Akita Maru from Akita, the Sagami Maru from Kanagawa, and the Shiratori Maru from Aichi, making five vessels which were in operation in May. In June besides the Aomori Maru there were eight vessels, and in July there were

also eight in addition to the Miyagi Maru. In August there were two vessels besides the Miyagi Maru, and in September five were operating in addition to the Shiratori Maru. The Aomori's engines broke down and she returned to port without fishing. In October five vessels besides the Miyagi Maru operated. On October 31 the operations were wound up and on November 12 the Aomori Maru returned to Misaki, marking the end of the operations for this year. The total number of vessel operations totaled 29 (see Chart 2). The gear used was chiefly the longlines described in Table 3.

(2) Outline of the results of the operations

The results of the operations of each vessel are shown in Table 4, Combined Results of Operations; Table 5, Results of Operations for Each Voyage; Table 6, Report of Results of Each Voyage for Each Vessel ; and Figure 3, Track Charts of Each Vessel. The albacore catch ratio shown in Tables 4 and 5 is the percentage obtained by dividing the number of albacore taken by the number of hooks on the longlines employed.

Table 2 Personnel of Participating Vessels
[This table has been omitted from the translation.]

[Tables 4 and 5 are inserted here. There then follows in the original Table 6, which is the complete fishing log for each trip of each vessel. These log sheets have been omitted from the translation because most of the essential information contained in them is presented in Tables 4 and 5. Table 6 is followed by the track charts of each vessel.]

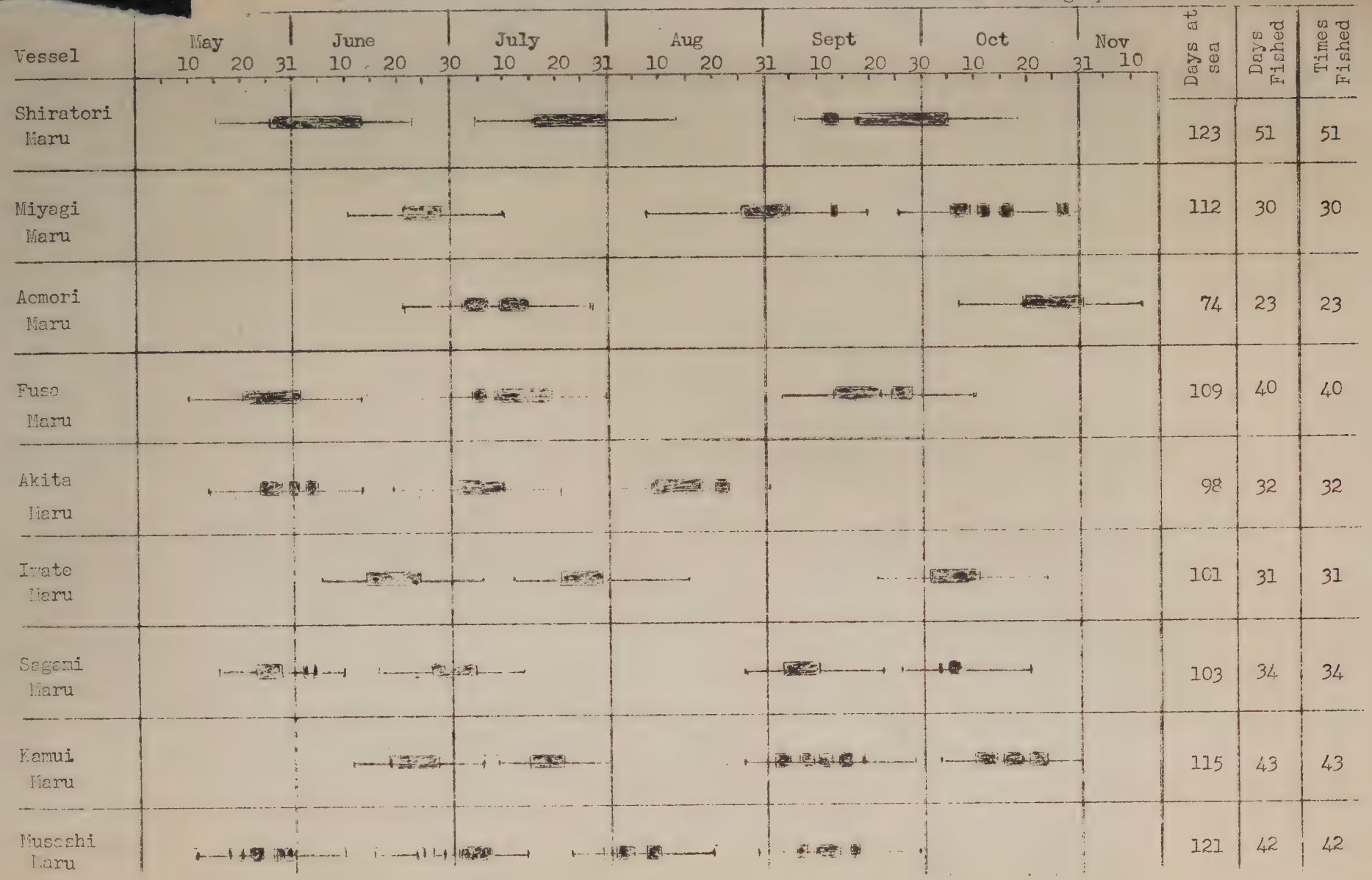
Table 1 Participating Prefectures and Vessels Used

Vessel	Prefecture	Area	Call Letters	Type	Length	Beam	Depth	Tonnage	Horse-power (net)	Radio Equip., power(W) Radio	Radio-telephone	Refrigerator Type	Capacity	Auxiliary Fishing Equipment	Date Launched
Shiratori Maru	Aichi	I	JVOJ	motor	36.50 m	7.30 m	3.30 m	269.78	450 (Diesel)	(med)500 (short)200	250	ammonia refrigerator	17.2 tons	Fukushima-type elec. line-hauler	8-35
Miyagi Maru	Miyagi	I	JAUG	*sail	33.05	7.10	3.35	248.23	400	(med)500 (short)200	250	ammonia refrigerator	10 tons	Fujita-type elec. line-hauler	2-34
Aomori Maru	Aomori	I	JLMI	motor	31.50	6.70	3.10	185.88	320	(med)500 (short)200	250	ammonia refrigerator	---	Fukushima-type elec. line-hauler	11-34
Fusa Maru	Chiba	II	JCPE	motor	34.10	6.70	3.10	176.60	320	(med)500	250	ammonia refrigerator	2 tons	Fujita-type elec. line-hauler	2-29
Iwate Maru	Iwate	II	JYCB	*sail	31.85	6.25	2.97	158.42	250	(med)500	250	ammonia refrigerator	10 tons	Electric line-hauler	8-33
Akita Maru	Akita	II	JMTF	motor	29.70	6.10	3.00	139.49	250	(med)150 (short)60	75	ammonia refrigerator	2 tons	Fukushima-type elec. line-hauler	8-33
Kamui Maru	Mie	III	JVAB	*sail	27.43	6.10	2.02	138.30	275	(med)250	---	ice	---	Fujita-type 2 HP elec. line-hauler	2-27
Sagami Maru	Kanagawa	III	JFUC	*sail	28.65	6.10	2.80	136.00	250	(med)500 (short)200	250	ice	---	Fujita-type elec. line-hauler	11-30
Musashi Maru	Tokyo	III	JGWC	*sail	25.50	5.71	2.74	104.54	250	(med)500	250	ammonia refrigerator	0.5 ton	Fujita-type 3 HP elec. line-hauler	3-32

*auxiliary sailing vessels

...shing Days for Each Voyage of Each Vessel

The lines show the time from sailing to return to port.
The bars show fishing operations.



Vessel	Days at sea	Days Fished	Times Fished
Shiratori Maru	123	51	51
Miyagi Maru	112	30	30
Aomori Maru	74	23	23
Fuso Maru	109	40	40
Akita Maru	98	32	32
Iwate Maru	101	31	31
Sagami Maru	103	34	34
Kamui Maru	115	43	43
Musashi Maru	121	42	42

/Data from/ Table 3 Table of Longline Gear

/TN/ 1 sun = 1.2 inches, 1 shaku = 0.994 foot, 1 momme = 0.1325 ounce
A Japanese fathom is approximately 5 feet long. The weight of line is given as so many momme per fathom. Sekiyama is the type of line used to connect the main part of a branch line and the wire leader. It is made of a hemp or wire core wrapped with cotton. Hook length is the total length from eye to point around the curve of the hook.

Shiratori Maru of Aichi Prefecture - 269.78 tons, 450 HP

Trunk Lines - Cotton, 3x3 strands, left-twist, 10 count weighing 10 momme per /Japanese/ fathom, each 150 fathoms long.

Branch Lines -

Large - Cotton, 3x3 strands, left-twist, 10 count weighing 11 momme, 6 fathoms long, 3 lines per basket. Brass swivels-Large 3

Small - Same material as large branches, 10 count weighing 7 momme, 4 fathoms long, 8 lines per basket. Brass swivels-small 8

Sekiyama - 3x3 strands on a wire core, same material for both large and small branch lines. 4 fathoms long on large lines, 3 fathoms on small lines.

Wire - 3x3 strands, 1.8 fathoms long on the large branches, 1.5 on the small.

Hooks - Zinc-plated iron, 4.5 sun size, and 3.0 sun size.

Float Lines - Manila, 3x3 left twist, 7 momme, 12.5 fathoms long, 1 line per basket.

Floats - glass balls, 10 inches in diameter.

This vessel carried 200 baskets of line.

Miyagi Maru of Miyagi Prefecture - 248.22 tons, 400 HP

Trunk Lines - Cotton, 3x3 twist, 9 momme, 195 fathoms long.

Large Branches - Cotton, 3x3 twist, 9 momme, 7 fathoms long, 2 lines per basket. Sekiyama is 3x3 twist on a core of Yashū hemp 3 fathoms long. Wire is 3x3 No.26 2.0 fathoms long. Hooks are tinned iron, 4.0 sun size.

Small Branches - Same material, 8 momme, 3 fathoms long, 10 lines per basket. Sekiyama is 3x3 twist on a core of Yashū hemp and is 2.5 fathoms long. Wire is same size and kind as on large branches. Hooks are same type as on large branches but are 3.2 sun long.

Float Lines - 4-strand Manila, 7 momme weight, 15 fathoms long, 2 per

data from Table 3 /Continued/

basket.

Floats - Paulownia logs, 3 sun in diameter and four shaku long.

This vessel carried 300 baskets of longlines.

Aomori Maru from Aomori Prefecture - 185.88 tons, 320 HP

Trunk Lines - 3x3 twist cotton, 9 momme weight, 180 fathoms long.

Large Branches - Cotton, 3x3 twist, 9 momme weight, 7 fathoms long, 2 lines per basket.

Small Branches - Same type of line as large branches, 6 momme weight, 4 fathoms long, 9 lines per basket.

Sekiyama - 3x3 strands on a 9-strand wire core, 4 fathoms long, on the large branch lines. Small branch lines evidently have no sekiyama.

Wire - 3x4 strands, 1.5 fathoms long on the large branches. 3x3 strands 2 fathoms long on the small branches.

Hooks - Tinned iron, 4.0 sun long on the large branches, 2.8 sun long on the small branches.

Float Lines - Cotton 3x3 strands, 9 momme weight, 10 fathoms long, 1 line per basket.

Floats - Glass balls, 9 sun diameter.

This vessel carried 200 baskets of longlines.

Fusa Maru of Chiba Prefecture - 176.60 tons, 320 HP

Trunk Lines - Manila, 10 momme weight, 150 fathoms.

Large Branches - Manila, 10 momme weight, 7.5 fathoms long, 3 lines per basket. The sekiyama is cotton on a hemp core and is 3 fathoms long. The wire is 4x2 strands (580 pounds) and is 9 shaku long. The hooks are Murakami "Supreme", 4.0 sun long.

Small Branches - Cotton line, 5 momme weight, 5 fathoms long, 8 lines per basket. Apparently no sekiyama is used. The wire is 3x3 strands, 9 shaku long. Hooks are of the same type as those used on the large branches but are only 2.8 sun long.

Float Lines - Manila, 8 momme weight, 18 fathoms long, 1 line per basket.

data from Table 3 [Continued]

Floats - Glass balls, 12 sun in diameter.

This vessel carried 170 baskets of gear.

Iwate Maru of Iwate Prefecture - 158.42 tons, 250 HP

Trunk Lines - Cotton, 8 momme weight, 180 fathoms long.

Large Branches - Cotton, 8 momme weight, 5 fathoms long, 3 lines per basket. Brass swivels, size Large 3. The sekiyama has a core of No.26 wire and is 3 fathoms long. The wire leader is 3x4 strands of No.28 wire and is 1.5 fathoms long. The hooks are tinned iron 3.5 sun long.

Small Branches - Cotton, 7 momme weight, 2 fathoms long, 8 lines per basket. Swivels are brass, size Small 8. The sekiyama has a core of No.29 wire and is 2 fathoms long. The wire leader is 3x3 strands of No.29 wire and is 1.5 fathoms long. The hooks are tinned iron and are 2.8 sun long.

Float Lines - Cotton, 7 momme weight, 18 fathoms long, 1 line per basket.

Floats - Glass balls, 9 sun in diameter.

This vessel carried 100 baskets of gear.

Akita Maru of Akita Prefecture - 139.49 tons, 250 HP

Trunk Lines - Cotton, 3x3 strands, 10 momme weight, 200 fathoms long.

Large Branches - Cotton, 3x3 strand, 10 momme weight, 8 fathoms long, 2 lines per basket. Swivels are brass, size Large 2. The sekiyama has a core of No.26 wire and is 4.5 fathoms long. The wire leader is 3x4 strands of No.29 wire and is 1.5 fathoms long. The hooks are tinned iron and are 4.0 sun long.

Small Branches - Cotton, 3x3 strand, 5 momme weight, 2 fathoms long, 9 lines per basket. Brass swivels, size Small 9. The sekiyama is made on a core of No.29 wire and is 3 fathoms long. The leader is 3x3 strands of No.29 wire and is 1.5 fathoms long. The hooks are tinned iron and are 2.8 sun long.

Float Lines - Cotton, 3x3 strands, 5 momme weight, 20 fathoms long, 1 line per basket.

Floats - Glass balls, 10 sun in diameter.

This vessel carried 200 baskets of gear.

---

data from Table 3 [Continued]

LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS

Kamui Maru of Mie Prefecture - 138.30 tons, 275 HP

Trunk Lines - Manila, 10 momme weight, 150 fathoms long.

Large Branches - Manila, 10 momme weight, 12 fathoms long, 3 lines per basket. Brass swivels, size Large 3. Sekiyama is 3x3 strands on a core of No.29 wire and is 4 fathoms long. Leader is 3x3 strands of No.28 wire 1 fathom long. Hooks are iron and are 4.2 sun long.

Small Branches - Cotton line, 6 momme weight, 4.5 fathoms long, 8 lines per basket. Brass swivels, size Small 8. No Sekiyama. Leader is 3x3 strands of No.28 wire and is 4 shaku long. Hooks are iron, 2.8 sun long.

Float Lines - Cotton, 8 momme weight, 18 fathoms long, 1 line per basket.

Floats - Paulownia logs 35 sun long, and glass balls 8 sun in diameter.

This vessel carried 150 baskets of gear.

Sagami Maru of Kanagawa Prefecture - 136.00 tons, 250 HP

Trunk Lines - Manila and 3x3 strand cotton, the Manila of 8 momme weight and the cotton of 10 momme. The lines are 180 fathoms long.

Large Branches - Cotton, 3x3 strands, 10 momme weight, 7 fathoms long, 3 lines per basket. No swivels. Sekiyama is 3x3 strands on a core of No.26 wire and is 4 fathoms long. Leader is 3x3 strands of No.26 wire and is 2.0 fathoms long. Hooks are tinned iron and are 4.0 sun long.

Small Branches - Cotton, 3x3 strands, 7 momme weight, 4 fathoms long, 8 lines per basket. Brass swivels, size Small 8. Sekiyama is 3x3 strands on a core of No.29 wire and is 1.5 fathoms long. Leader is 3x3 strands of No.29 wire and is 2 fathoms long. Hooks are tinned iron, 3.0 and 2.8 sun long.

Float Lines - Manila, 8 momme weight, 20 fathoms long, 1 line per basket.

Floats - Paulownia logs 35 sun long, and glass balls 10 sun in diameter.

This vessel carried 190 baskets of gear.

Musashi Maru of Tokyo Metropolitan District - 104.54 tons, 250 HP

Trunk Lines - Cotton, 10 momme weight, 180 fathoms long.

Large Branches - Cotton, 10 momme weight, 8 fathoms long, 2 lines per

basket. Brass swivels, size Large 2. Sekiyama is 3x4 strands on a core of wire and is 4 fathoms long. Leader is 4x4 strands of wire 2 fathoms long. Hooks are tinned iron 4.0 sun long.

Small Branches - Cotton, 6 momme weight, 5 fathoms long, 8 lines per basket. Brass swivels, size Small 8. Sekiyama is 3x3 strands on a wire core and is 2 fathoms long. Leader is 3x3 strands of wire 2.0 fathoms long. Hooks are tinned iron 2.0 sun long.

Float Lines - Cotton, 6 momme weight, 12 fathoms long, 1 line per basket

Floats - Paulownia logs 4 sun in diameter and 3 shaku long. Glass balls 10 sun in diameter.

This vessel carried 100 baskets of gear.

Table 4 Summary of the Results of Operations [Continued] 180-20 150-18 180-12

Vessel	Iwate Maru	Sagami Maru	Kamui Maru	Musashi Maru	Totals
Date Operations Began	6-5	5-16	6-11	5-11	
Date Operations Ended	10-24	10-16	10-31	9-28	
Number of Cruises	3	4	4	4	30
Total Number of Days Required	101	103	115	121	956
Total Days on the Fishing Grounds	31	42	49	53	382
Total Days Fished	31	34	43	42	326
Total Times Fished	31	34	43	42	326
Total Baskets of Gear Fished	3,410	3,380	4,770	4,100	38,671
Total Hooks Fished	37,510	37,180	52,470	41,000	425,398
Total Number of Fish Caught	1,468	632	6,036	856	21,900
Albacore	1,017	164	436	248	11,753
Other Tunas	92	151	120	301	1,166
Spearfishes	26	62	89	49	408
Sharks	292	218	295	235	3,283
Other Fish	41	37	5,096	23	5,290
Albacore Catch Rate [fish per 100 hooks]	2.71	0.44	0.83	0.60	2.76
Value of Catch	¥8,227.045	6,543.02	9,884.92	9,309.69	81,219.275

Table 5 Results of Operations by Cruises First Cruise

Vessel	Shiratori Maru	Miyagi Maru	Aomori Maru	Fusa Maru	Akita Maru
Date Left Port	5-16	6-10	6-21	5-10	5-14
Date Returned to Port	6-23	7-10	7-27	6-12	6-13
Days Required	39	31	37	34	31
Days on the Grounds	17	7	13	12	11
Days Fished	17	7	12	12	9
Times Fished	17	7	12	12	9
Total Baskets Fished	2,805	906	1,647	1,271	960
Total Hooks Fished	30,855	10,872	18,117	13,981	10,560
Total Fish Taken	3,492	147	324	397	79
Albacore	3,175	54	38	243	12
Other Tunas	111	22	83	32	13
Spearfishes	—	5	26	—	5
Sharks	191	61	171	116	49
Other Fish	15	5	6	6	—
Albacore Catch Rate (fish per 100 hooks)	10.29	0.50	0.21	1.74	0.12
Total Value of Catch	8,665.54	722.37	1,906.79	1,246.41	663.89

Table 5 First Cruise [Continued]

Vessel	Iwate Maru	Sagami Maru	Kamui Maru	Musashi Maru	Totals
Date Left Port	6-5	5-16	6-11	5-11	
Date Returned to Port	7-6	6-10	7-6	6-9	
Days Required	32	26	26	30	286
Days on the Grounds	10	12	10	14	106
Days Fished	10	9	10	11	97
Times Fished	10	9	10	11	97
Total Baskets Fished	950	900	1,182	1,050	11,671
Total Hooks Fished	10,450	9,900	13,002	10,500	128,237
Total Fish Taken	167	149	139	412	5,306
Albacore	—	56	—	244	3,822
Other Tunas	41	38	46	111	497
Spearfishes	14	3	10	7	70
Sharks	106	52	83	46	875
Other Fish	6	—	—	4	42
Albacore Catch Rate (fish per 100 hooks)	0	0.57	0	2.50	2.98
Total Value of Catch	1,274.336	1,057.15	1,028.13	2,645.31	19,209.926

Table 5 Results of Operations by Cruises Second Cruise

Vessel	Shiratori Maru	Miyagi Maru	Aomori Maru	Fusa Maru	Akita Maru
Date Left Port	7-5	8-7	9-3	6-25	6-19
Date Returned to Port	8-14	9-19	9-25	7-31	7-21
Days Required	41	44	engine broke down, operations called off	37	33
Days on the Grounds	16	18		15	10
Days Fished	16	11		14	10
Times Fished	16	11		14	10
Total Baskets Fished	2,432	1,561		1,752	1,142
Total Hooks Fished	26,752	18,732		19,272	12,562
Total Fish Taken	1,997	269		300	109
Albacore	1,219	128		50	4
Other Tunas	14	7		80	14
Spearfishes	1	4		23	20
Sharks	754	115		143	70
Other Fish	9	15		4	1
Albacore Catch Rate (fish per 100 hooks)	4.55	0.68		0.25	0.03
Total Value of Catch	3,639.92	1,421.66		1,654.32	709.06

Table 5 Second Cruise [Continued]

Vessel	Iwate Maru	Sagami Maru	Kamui Maru	Musashi Maru	Totals
Date Left Port	7-12	6-17	7-8	6-15	
Date Returned to Port	8-15	7-14	7-31	7-14	
Days Required	35	28	24	30	272
Days on the Grounds	10	13	8	15	105
Days Fished	10	11	8	11	91
Times Fished	10	11	8	11	91
Total Baskets Fished	1,210	1,080	1,040	1,100	11,317
Total Hooks Fished	13,310	11,880	11,440	11,000	124,948
Total Fish Taken	244	193	5,141	151	8,404
Albacore	67	2	—	1	1,471
Other Tunas	47	66	12	37	277
Spearfishes	9	16	25	13	111
Sharks	87	107	73	99	1,448
Other Fish	34	2	5,031	1	5,097
Albacore Catch Rate (fish per 100 hooks)	0.50	0.02	0	0.01	1.18
Total Value of Catch	2,017.33	1,395.46	2,879.84	997.68	14,715.27

Table 5 Results of Operations by Cruises Third Cruise

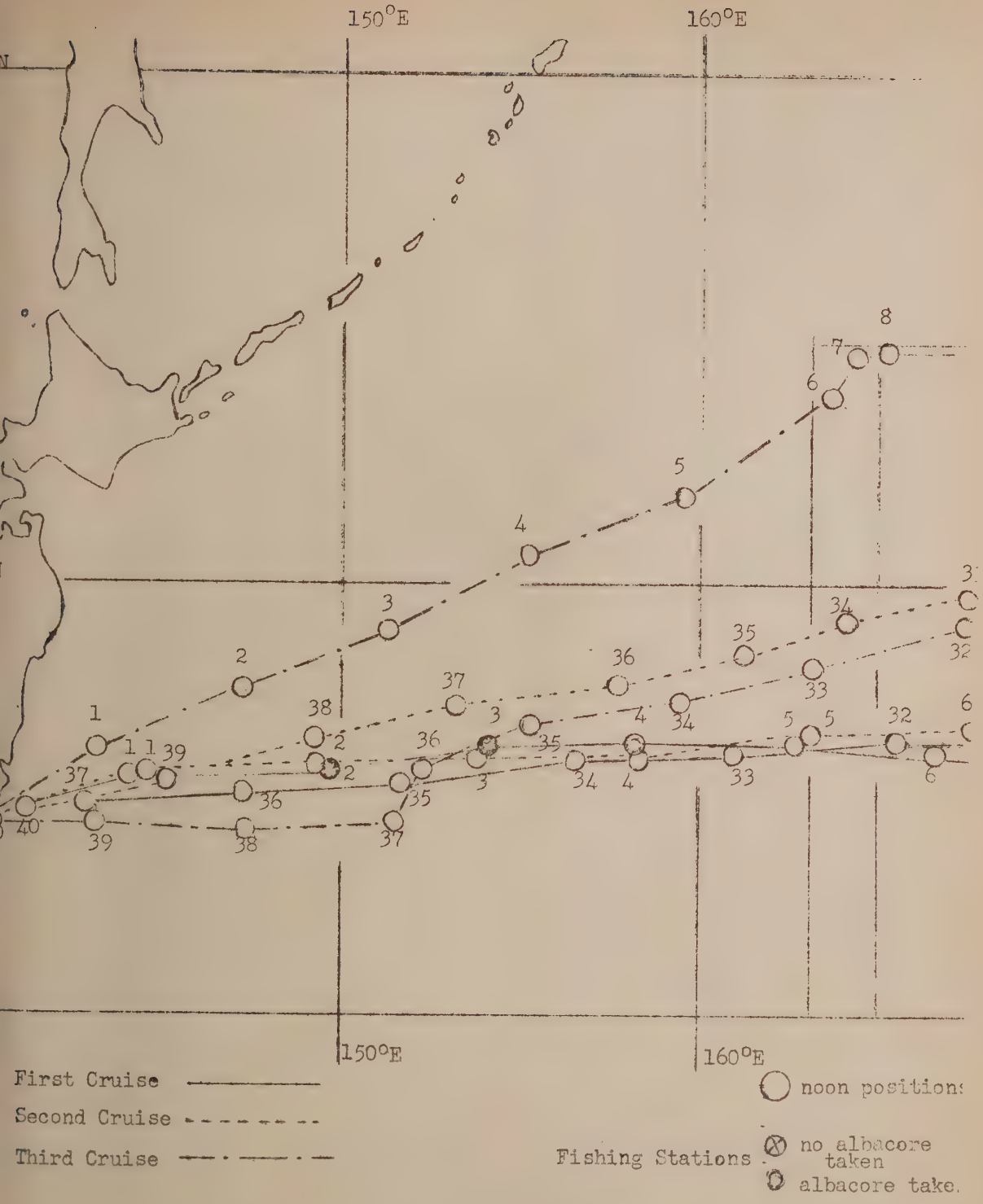
Vessel	Shiratori Maru	Miyagi Maru	Aomori Maru	Fusa Maru	Akita Maru
Date Left Port	9-6	9-25	10-7	9-3	7-30
Date Returned to Port	10-18	10-31	11-12	10-10	9-1
Days Required	43	37	37	38	34
Days on the Grounds	23	23	12	15	15
Days Fished	18	12	11	14	13
Times Fished	18	12	11	14	13
Total Baskets Fished	2,307	1,650	1,372	1,646	1,560
Total Hooks Fished	25,377	19,800	15,092	18,106	17,160
Total Fish Taken	2,219	1,371	1,738	289	177
Albacore	2,008	1,156	1,615	162	24
Other Tunas	3	—	16	49	58
Spearfishes	3	9	2	49	35
Sharks	176	205	103	29	60
Other Fish	29	—	2	—	—
Albacore Catch Rate (fish per 100 hooks)	7.99	5.84	10.70	0.90	0.14
Total Value of Catch	6,611.10	4,033.14	6,466.16	1,924.46	7,589.78

Table 5 Third Cruise [Continued]

Vessel	Iwate Maru	Sagami Maru	Kamui Maru	Musashi Maru	Totals
Date Left Port	9-21	8-26	8-25	7-22	
Date Returned to Port	10-24	9-22	9-28	8-20	
Days Required	34	28	35	30	316
Days on the Grounds	11	12	17	12	140
Days Fished	11	10	13	10	112
Times Fished	11	10	13	10	112
Total Baskets Fished	1,251	1,000	1,300	950	13,035
Total Hooks Fished	13,750	11,000	14,300	9,500	144,085
Total Fish Taken	1,057	157	204	123	7,335
Albacore	950	9	16	1	5,941
Other Tunas	4	47	49	58	284
Spearfishes	3	36	36	9	182
Sharks	99	44	68	46	830
Other Fish	1	21	35	9	98
Albacore Catch Rate (fish per 100 hooks)	6.91	0.08	0.11	0.01	4.12
Total Value of Catch	4,935.379	3,099.59	3,334.07	3,006.64	41,000.319

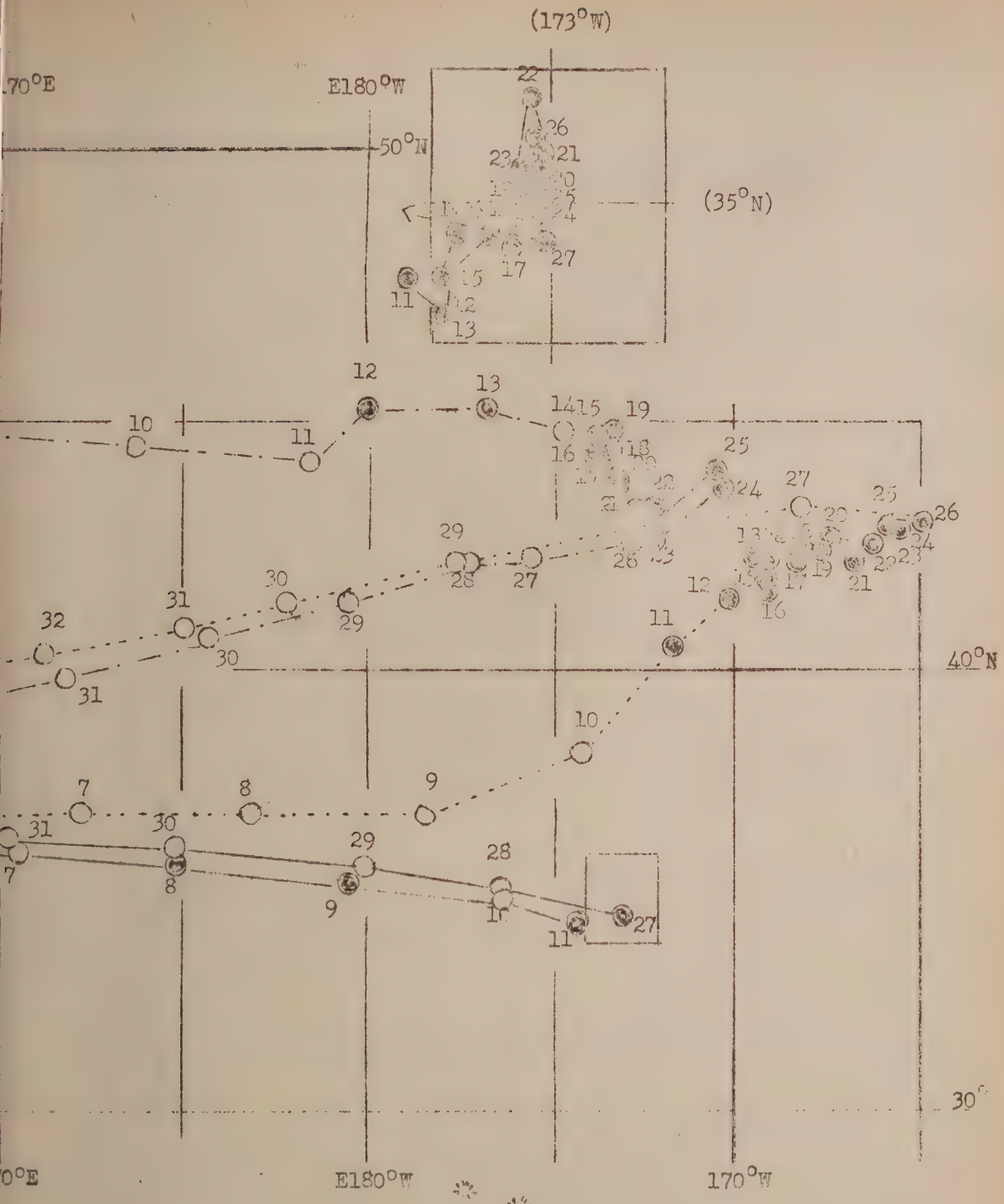
Table 5 Results of Operations by Cruises Fourth Cruise

Vessel	Sagami Maru	Kamui Maru	Musashi Maru	Totals
Date Left Port	9-26	10-2	8-29	
Date Returned to Port	10-16	10-31	9-28	
Days Required	21	30	31	82
Days on the Grounds	5	14	12	31
Days Fished	4	12	10	26
Times Fished	4	12	10	26
Total Baskets Fished	400	1,248	1,000	2,648
Total Hooks Fished	4,400	13,728	10,000	28,128
Total Fish Taken	133	552	170	855
Albacore	97	420	2	519
Other Tunas	—	13	95	108
Spearfishes	7	18	20	45
Sharks	15	71	44	130
Other Fish	14	30	9	53
Albacore Catch Rate (fish per 100 hooks)	2.20	3.06	0.02	1.85
Total Value of Catch	990.82	2,642.88	2,660.06	6,293.76



Track Chart of the Shiratori Maru

Track Chart of the Shiratori Maru (Cont'd)



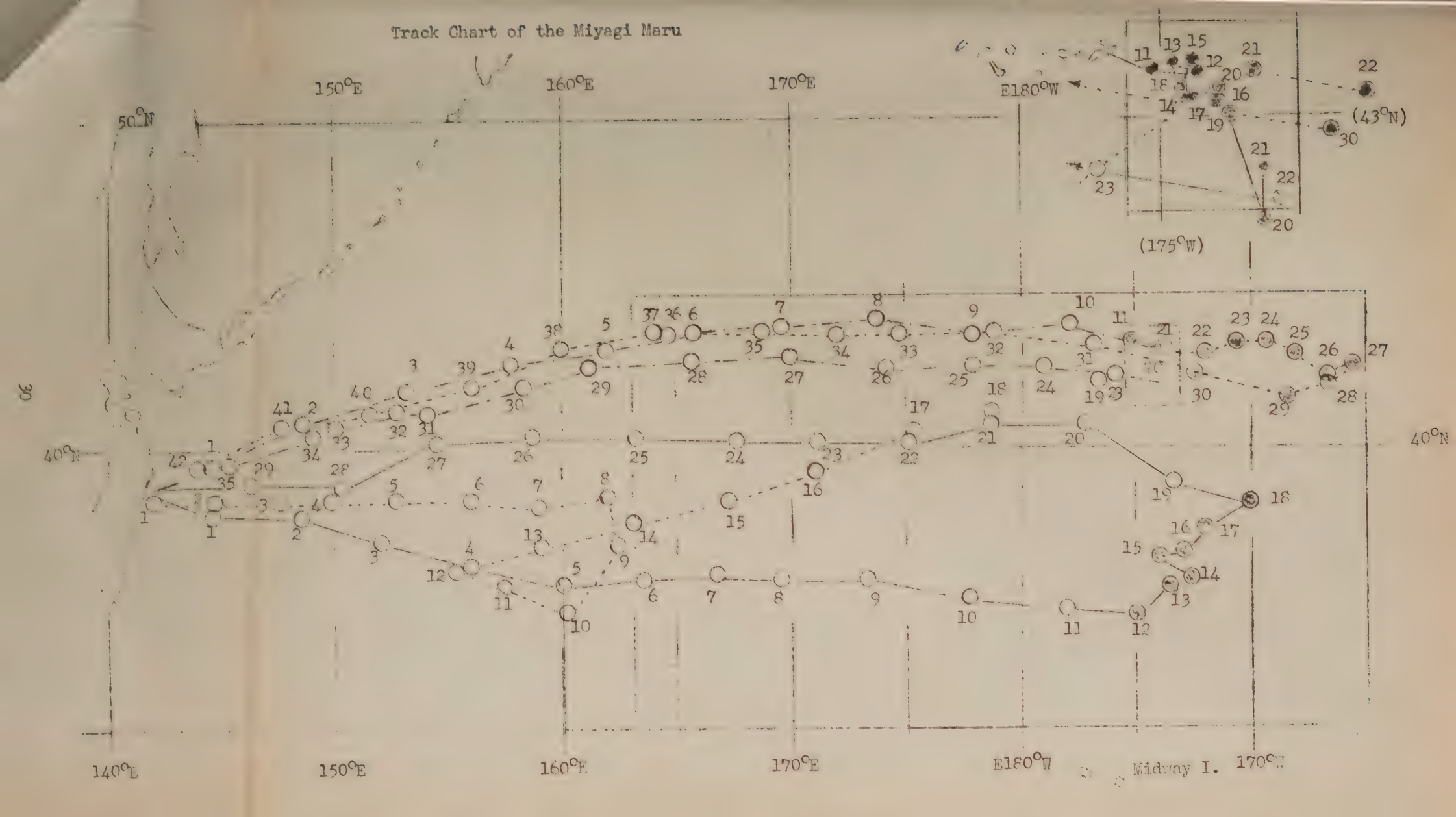
[Table accompanying track chart, Shiratori Maru]

Station No.	Cruise No. 1			Cruise No. 2			Cruise No. 3		
	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)
1	5-17	18.6	*	7-6	23.2	*	9-7	27.4	*
2	18	16.1	4	7	23.5	*	8	27.0	*
3	19	15.0	5	8	23.0	*	9	24.0	*
4	20	17.5	9	9	19.5	*	10	22.7	*
5	21	16.7	*	10	20.0	*	11	20.2	*
6	22	16.7	*	11	21.0	*	12	17.7	*
7	23	18.0	*	12	20.7	*	13	16.5	93
8	24	18.0	1	13	19.0	*	14	15.8	82
9	25	17.5	2	14	23.8	*	15	14.6	*
10	26	16.8	*	15	20.6	*	16	13.8	*
11	27	17.7	184	16	20.3	15	17	16.5	*
12	28	17.7	290	17	18.7	19	18	16.3	87
13	29	18.6	330	18	18.8	93	19	16.4	67
14	30	17.8	333	19	17.2	50	20	17.0	*
15	31	18.1	446	20	17.7	100	21	15.9	101
16	6-1	18.5	214	21	18.0	106	22	16.3	281
17	2	18.3	230	22	16.7	57	23	15.8	104
18	3	17.6	64	23	16.5	67	24	16.3	165
19	4	18.2	112	24	17.0	107	25	15.7	229
20	5	18.1	138	25	15.8	81	26	14.5	126
21	6	17.5	173	26	17.8	82	27	15.5	86
22	7	17.8	97	27	17.0	94	28	16.9	147
23	8	18.2	191	28	16.9	100	29	16.0	103
24	9	18.0	201	29	17.0	96	30	17.0	40
25	10	18.2	120	30	17.0	81	10-1	15.9	56

Table accompanying track chart, Shiratori Maru [Continued]

Station No.	Cruise No. 1			Cruise No. 2			Cruise No. 3		
	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)
26	6-11	17.8	35	7-31	15.7	70	10-2	15.3	60
27	12	18.9	14	8- 1	16.6	*	3	16.8	0
28	13	16.8	*	2	16.7	*	4	16.7	125
29	14	17.7	*	3	19.8	*	5	16.7	54
30	15	17.2	*	4	22.8	*	6	17.3	*
31	16	18.2	*	5	19.9	*	7	21.0	*
32	17	17.5	*	6	22.5	*	8	21.5	*
33	18	19.9	*	7	23.4	*	9	23.7	*
34	19	16.0	*	8	23.1	*	10	23.8	*
35	20	20.6	*	9	24.7	*	11	23.5	*
36	21	22.1	*	10	24.5	*	12	23.0	*
37	22	21.6	*	11	24.0	*	13	22.0	*
38	-	-	-	12	25.2	*	14	24.8	*
39	-	-	-	13	25.0	*	15	24.8	*
40	-	-	-	14	25.9	*	16	24.7	*
41	-	-	-	-	-	-	17	23.0	*
42	-	-	-	-	-	-	18	23.2	*
Total			3,175			1,219			2,008
Left port	5-16	Misaki		7- 5	Misaki		9- 5	Misaki	
Returned to port	5-23	Misaki		8-14	Misaki		10-18	Misaki	

Track Chart of the Miyagi Maru



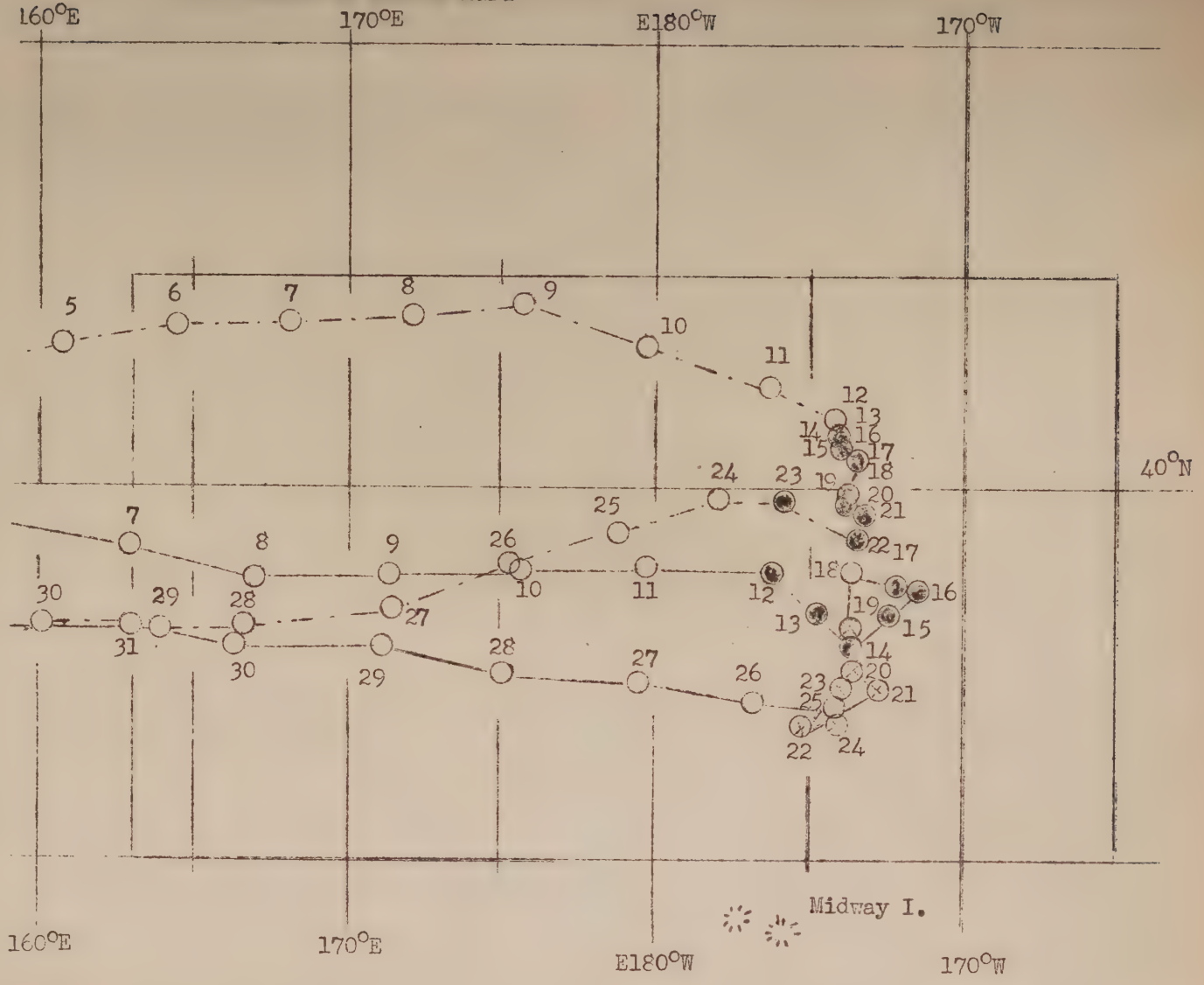
[Table accompanying track chart, Miyagi Maru]

Station No.	Cruise No. 1			Cruise No. 2			Cruise No. 3		
	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)
1	6-11	18.4	*	8-8	23.9	*	9-26	21.9	*
2	12	19.9	*	9	23.5	*	27	18.9	*
3	13	20.2	*	10	21.8	*	28	20.0	*
4	14	17.2	*	11	23.7	*	29	19.3	*
5	15	19.2	*	12	23.8	*	30	19.5	*
6	16	17.8	*	13	25.2	*	10- 1	17.0	*
7	17	17.2	*	14	23.0	*	2	14.3	*
8	18	19.5	*	15	24.6	*	3	16.5	*
9	19	16.7	*	16	24.2	*	4	13.4	*
10	20	18.6	*	17	25.4	*	5	14.2	*
11	21	20.0	*	18	24.7	*	6	15.2	174
12	22	19.0	0	19	23.7	*	7	15.0	123
13	23	18.7	11	20	25.3	*	8	14.7	112
14	24	18.5	3	21	24.8	*	9	15.2	116
15	25	18.0	4	22	24.7	*	10	14.5	43
16	26	17.8	11	23	24.4	*	11	15.0	135
17	27	18.2	11	24	22.2	*	12	14.7	86
18	28	17.9	14	25	20.7	*	13	16.0	196
19	29	17.0	*	26	18.8	*	14	15.7	58
20	30	15.0	*	27	17.8	12	15	15.8	109
21	7-1	14.4	*	28	17.6	10	16	17.0	4
22	2	13.5	*	29	18.2	3	17	18.8	0
23	3	14.1	*	30	18.0	12	18	14.3	*
24	4	16.5	*	31	17.5	21	19	12.7	*
25	5	16.2	*	9-1	17.4	3	20	14.8	*

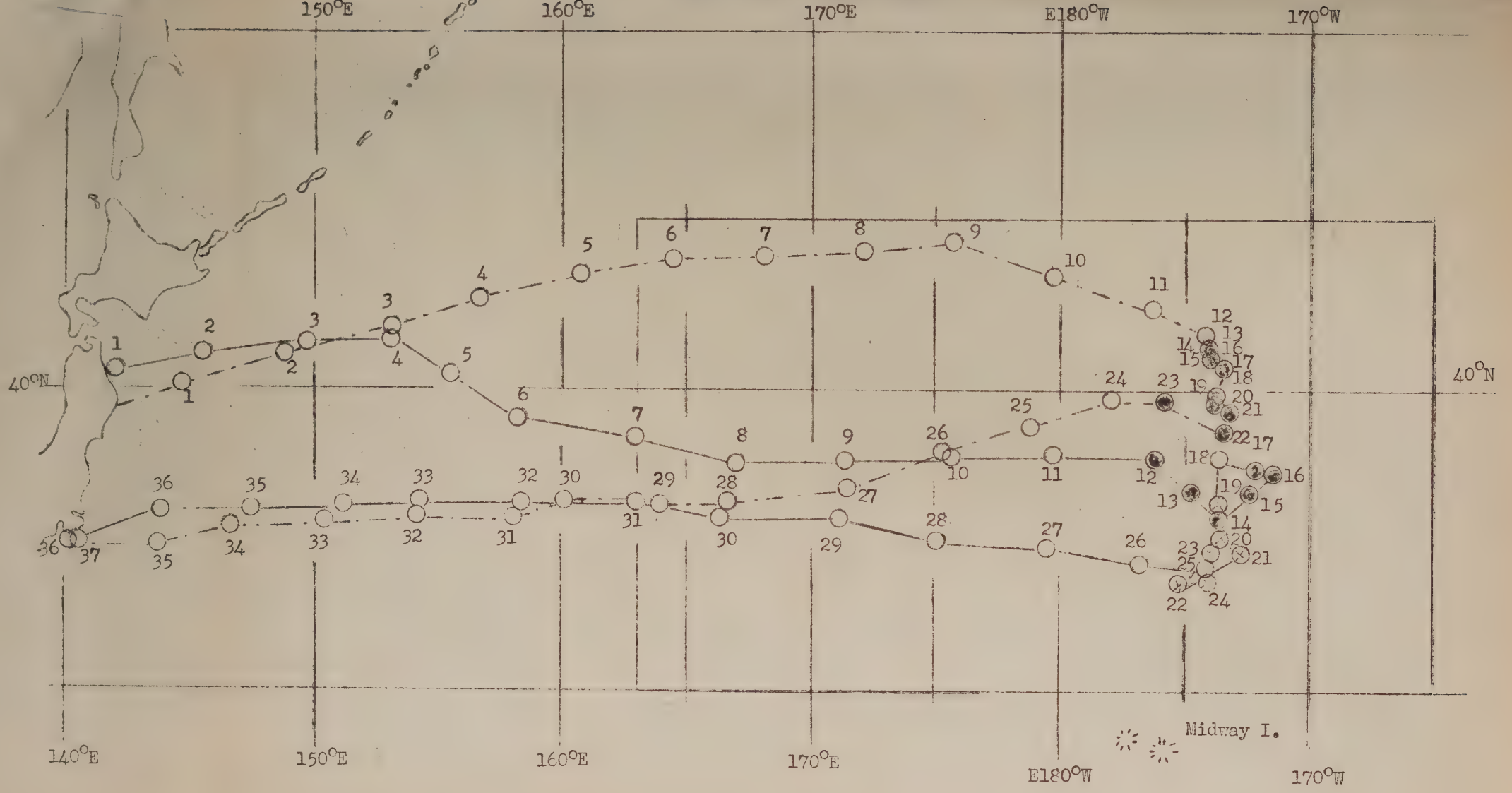
Table accompanying track chart, Miyagi Maru [Continued]

Station No.	Cruise No. 1			Cruise No. 2			Cruise No. 3		
	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)
26	7-6	16.7	*	9-2	18.1	6	10-23	19.4	*
27	7	18.5	*	3	18.0	12	24	17.0	*
28	8	19.3	*	4	19.3	9	25	16.3	*
29	9	19.2	*	5	20.6	13	24	16.2	*
30	10	20.0	*	6	17.6	27	25	14.0	*
31	-	-	-	7	18.6	*	26	15.8	*
32	-	-	-	8	18.5	*	27	14.3	*
33	-	-	-	9	17.1	*	28	14.2	*
34	-	-	-	10	17.2	*	29	15.8	*
35	-	-	-	11	14.5	*	30	15.5	*
36	-	-	-	12	16.6	*	-	-	-
37	-	-	-	13	17.7	*	-	-	-
38	-	-	-	14	18.9	*	-	-	-
39	-	-	-	15	21.5	*	-	-	-
40	-	-	-	16	23.5	*	-	-	-
41	-	-	-	17	23.2	*	-	-	-
42	-	-	-	18	20.6	*	-	-	-
Total			54			128			1,156
Left port	6-10	Kesennuma		8-7	Kesennuma		9-25	Kesennuma	
Returned to port	7-10	Kesennuma		9-19	Kesennuma		10-31	Kesennuma	

Track Chart of Aomori Maru



Track Chart of Aomori Maru

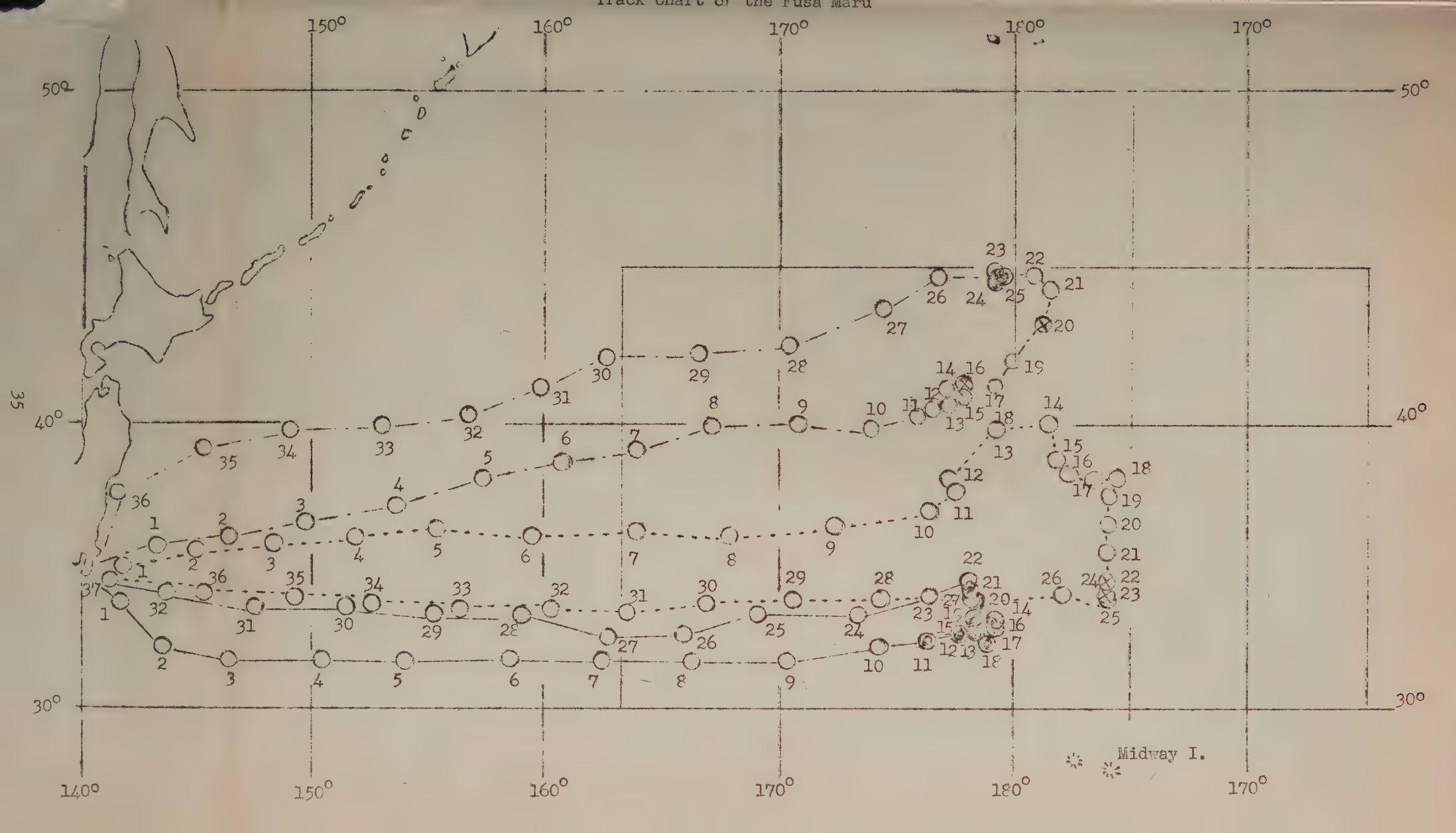


[Table accompanying track chart, Aomori Maru]

Station No.	Cruise No. 1 Date	Surface Water Temperature	Albacore catch (No. of fish)	Cruise No. 3 Date	Surface Water Temperature	Albacore catch (No. of fish)
1	6-22	14.2	*	10-7	24.0	*
2	23	13.0	*	8	21.0	*
3	24	13.2	*	9	17.4	*
4	25	11.7	*	10	19.0	*
5	26	15.8	*	11	18.0	*
6	27	18.7	*	12	16.5	*
7	28	17.5	*	13	15.5	*
8	29	18.4	*	14	11.5	*
9	30	17.6	*	15	12.4	*
10	7- 1	16.0	*	16	14.5	*
11	2	18.5	*	17	14.8	*
12	3	18.9	1	18	14.9	*
13	4	21.3	2	19	17.2	*
14	5	21.0	7	20	16.1	94
15	6	19.6	11	21	16.8	96
16	7	19.4	8	22	16.9	217
17	8	19.5	9	23	16.5	227
18	9	22.1	*	24	16.8	138
19	10	22.5	0	25	16.8	228
20	11	21.6	0	26	16.8	174
21	12	23.1	0	27	16.5	246
22	13	23.4	0	28	17.5	90
23	14	23.5	0	29	17.1	39
24	15	23.5	0	30	16.7	*
25	16	23.4	*	31	15.8	68
26	17	23.7	*	11-1	18.3	*
27	18	24.3	*	2	18.0	*
28	19	22.8	*	3	20.0	*
29	20	24.3	*	4	22.2	*
30	21	24.0	*	5	22.6	*
31	22	23.2	*	6	20.4	*
32	23	24.0	*	7	22.5	*
33	24	24.6	*	8	23.0	*
34	25	24.6	*	9	23.7	*
35	26	25.4	*	10	23.3	*
36	27	26.9	*	11	22.5	*
37	-	-	-	12	21.5	*
Total			38			1,615

Left port	6-21	Same	10- 7 Kamaishi
Returned to port	7-27	Katsuura	11-12 Misaki

Track Chart of the Fusa Maru

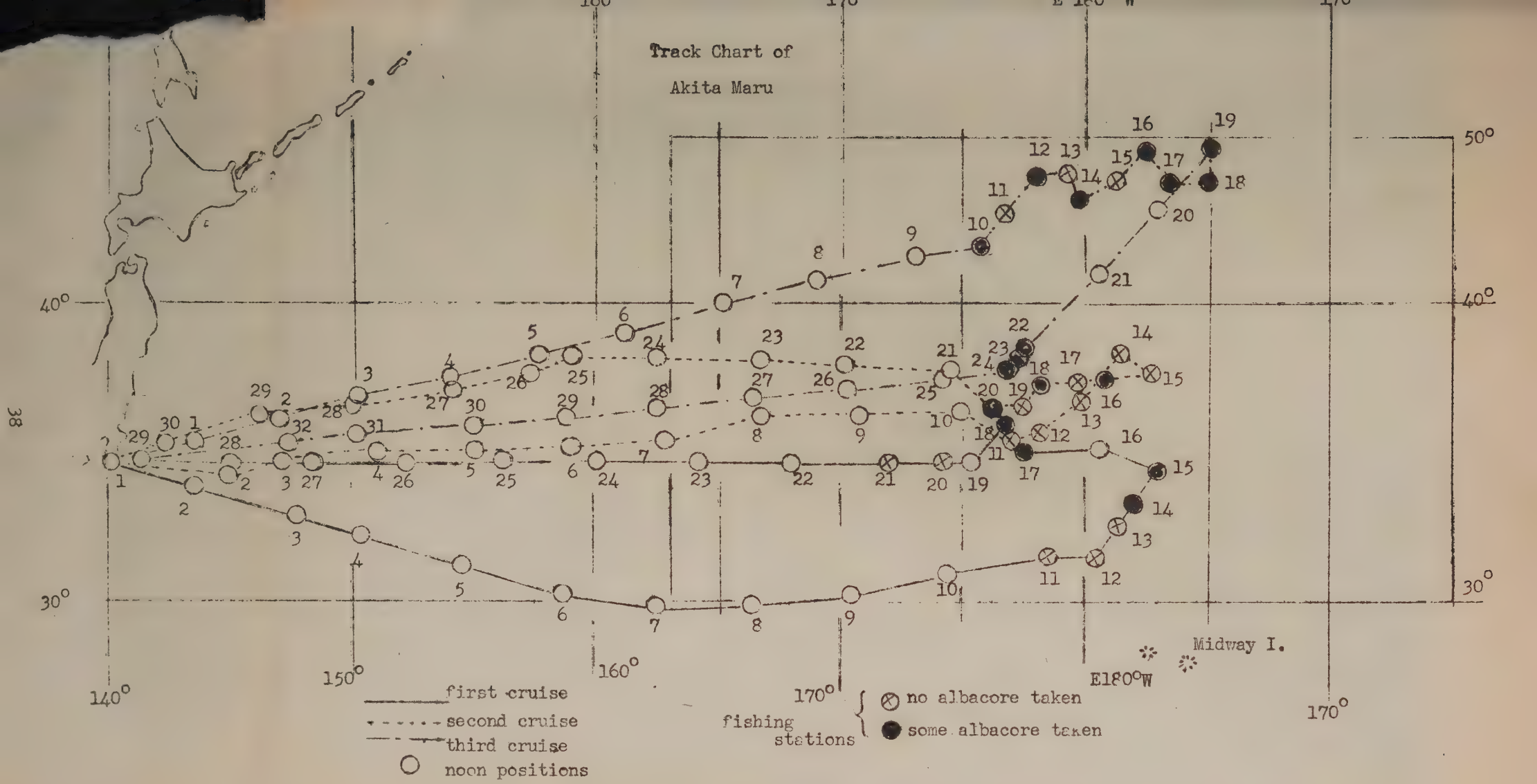


[Table accompanying track chart, Fusa Maru]

Station No.	Cruise No. 1			Cruise No. 2			Cruise No. 3		
	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)
1	5-11	19.2	*	6-25	21.4	*	9- 4	26.8	*
2	12	18.9	*	26	22.4	*	5	24.6	*
3	13	18.8	*	27	18.8	*	6	25.9	*
4	14	18.1	*	28	20.5	*	7	25.4	*
5	15	18.4	*	29	20.4	*	8	24.6	*
6	16	19.1	*	30	19.8	*	9	24.8	*
7	17	22.5	*	7- 1	18.7	*	10	22.2	*
8	18	20.9	*	2	19.6	*	11	22.0	*
9	19	19.4	*	3	19.5	*	12	21.8	*
10	20	19.1	*	4	19.5	*	13	21.8	*
11	21	18.8	2	5	17.7	3	14	21.5	5
12	22	19.7	15	6	18.1	1	15	20.7	11
13	23	18.1	52	7	17.6	1	16	20.8	7
14	24	18.8	40	8	15.7	3	17	21.3	1
15	25	18.2	19	9	16.5	10	18	21.6	0
16	26	17.8	3	10	17.9	15	19	20.3	0
17	27	18.2	7	11	18.9	9	20	21.3	12
18	28	19.2	3	12	19.0	4	21	21.1	4
19	29	18.5	6	13	19.6	1	22	19.7	3
20	30	18.5	9	14	20.8	2	23	16.0	0

Table accompanying track chart, Fusa Maru [Continued]

Station No.	Cruise No. 1			Cruise No. 2			Cruise No. 3		
	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)
21	5-31	18.1	59	7-15	21.0	1	9-24	14.0	13
22	6- 1	18.4	28	16	23.7	0	25	14.5	11
23	2	19.0	*	17	23.3	0	26	16.7	21
24	3	17.4	*	18	23.2	0	27	15.9	28
25	4	19.0	*	19	23.2	0	28	16.1	46
26	5	20.5	*	20	24.5	*	29	15.1	*
27	6	22.1	*	21	23.5	*	30	14.5	*
28	7	19.6	*	22	23.3	*	10-1	16.6	*
29	8	19.7	*	23	24.2	*	2	19.8	*
30	9	19.8	*	24	24.4	*	3	19.5	*
31	10	20.5	*	25	24.8	*	4	21.7	*
32	11	20.0	*	26	24.3	*	5	21.7	*
33	12	19.0	*	27	24.7	*	6	23.0	*
34	-	-	-	28	23.7	*	7	21.9	*
35	-	-	-	29	26.0	*	8	21.4	*
36	-	-	-	30	26.7	*	9	21.3	*
37	-	-	-	31	28.0	*	-	-	-
Total			243			50			162
Left port	5-10	Katsuura		6-25	Katsuura		9- 3	Katsuura	
Returned to port	6-12	Katsuura		7-31	Katsuura		10-10	Katsuura	


Track Chart of
Akita Maru
40°
30°
140°
150°
160°
170°
E180°W
Midway I.
first cruise
second cruise
third cruise
noon positions
fishing stations
no albacore taken
some albacore taken

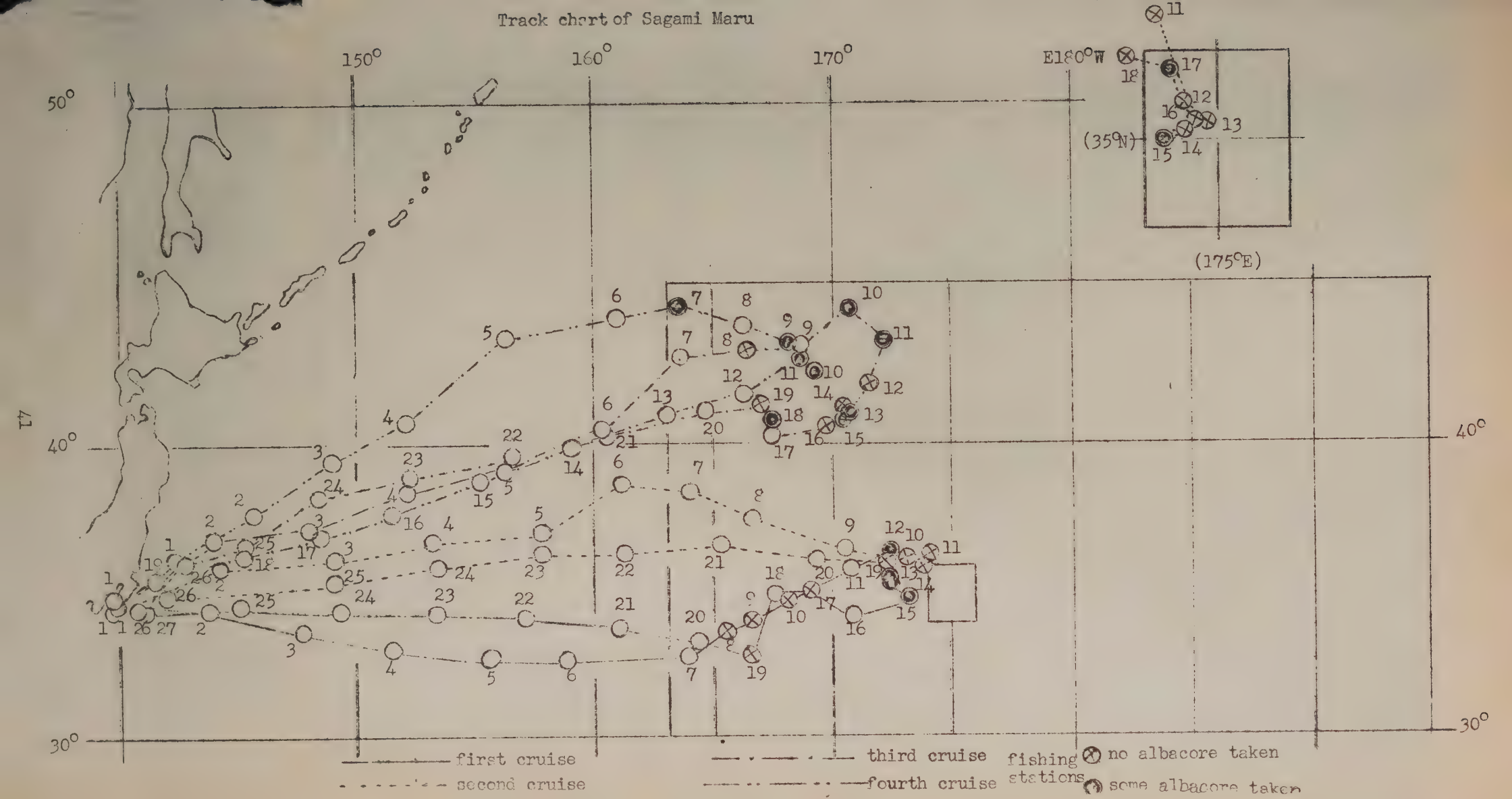
[Table accompanying track chart, Akita Maru]

Station No.	Cruise No. 1			Cruise No. 2			Cruise No. 3		
	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)
1	5-15	18.5	*	6-21	22.8	*	7-31	25.3	*
2	16	19.7	*	22	23.0	*	8- 1	23.8	*
3	17	20.5	*	23	22.0	*	2	22.5	*
4	18	18.8	*	24	19.0	*	3	22.3	*
5	19	19.5	*	25	15.7	*	4	21.9	*
6	20	22.5	*	26	15.8	*	5	20.5	*
7	21	23.0	*	27	18.5	*	6	20.8	*
8	22	23.9	*	28	17.5	*	7	19.5	*
9	23	23.8	*	29	17.5	*	8	18.3	*
10	24	24.0	*	30	18.5	*	9	18.3	1
11	25	20.5	0	7-1	20.0	0	10	18.0	0
12	26	19.5	0	2	18.4	0	11	17.3	2
13	27	18.9	0	3	18.3	0	12	17.5	0
14	28	18.3	4	4	19.0	0	13	18.0	1
15	29	18.6	1	5	19.5	0	14	17.5	0
16	30	17.0	*	6	20.0	1	15	16.8	1
17	31	18.0	6	7	19.0	0	16	17.3	4
18	6-1	17.8	1	8	20.7	1	17	17.3	3
19	2	16.9	*	9	20.3	0	18	16.8	2
20	3	17.9	0	10	20.3	2	19	21.2	*

Table accompanying track chart, Akita Maru [Continued]

Station No.	Cruise No. 1			Cruise No. 2			Cruise No. 3		
	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)	Date	Surface water temperature	Albacore catch (no. of fish)
21	6- 4	18.0	0	7-11	20.9	*	8-20	23.0	*
22	5	17.4	*	12	21.3	*	21	25.2	5
23	6	19.0	*	13	20.6	*	22	25.5	2
24	7	20.3	*	14	22.5	*	23	25.5	3
25	8	19.9	*	15	22.5	*	24	25.5	*
26	9	19.3	*	16	23.6	*	25	24.8	*
27	10	20.7	*	17	24.3	*	26	24.5	*
28	11	20.3	*	18	25.5	*	27	25.2	*
29	12	22.5	*	19	25.3	*	28	24.5	*
30	-	-	-	20	25.4	*	29	25.5	*
31	-	-	-	-	-	-	30	25.7	*
32	-	-	-	-	-	-	31	25.5	*
Total			12			4			24
Left port	5-14	Misaki		6-19	Misaki		7-30	Misaki	
Returned to port	6-13	Misaki		7-21	Misaki		9- 1	Misaki	

Track chart of Sagami Maru



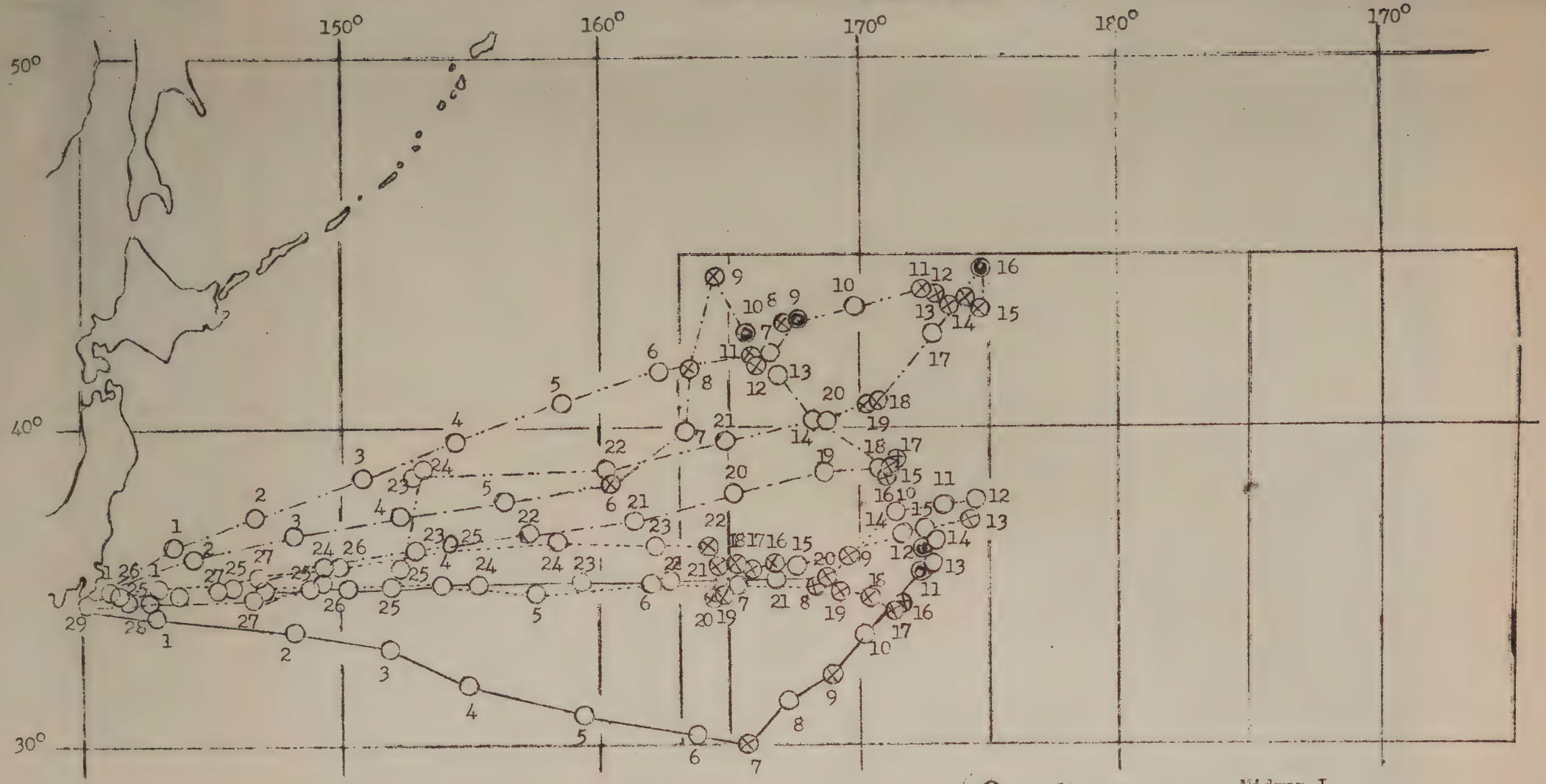
[Table accompanying track chart, Sagami Maru]

Station No.	Cruise No. 1			Cruise No. 2		
	Date	Surface Water Temperature	Albacore catch (No. of fish)	Date	Surface Water Temperature	Albacore catch (No. of fish)
1	5-16	16.7	*	6-17	20.5	*
2	17	19.0	*	18	22.5	*
3	18	19.9	*	19	16.8	*
4	19	18.2	*	20	20.3	*
5	20	18.3	*	21	17.8	*
6	21	21.0	*	22	16.6	*
7	22	20.8	*	23	16.4	0
8	23	19.1	0	24	17.3	*
9	24	19.1	0	25	19.0	*
10	25	17.7	0	26	17.7	0
11	26	18.2	*	27	17.5	0
12	27	17.6	35	28	18.4	0
13	28	17.7	10	29	18.8	0
14	29	17.5	4	30	18.8	0
15	30	17.0	7	7- 1	18.5	1
16	31	19.0	*	2	19.5	0
17	6- 1	19.5	0	3	18.6	1
18	2	17.2	*	4	18.5	0
19	3	19.1	0	5	19.4	0
20	4	20.1	*	6	20.3	*
21	5	18.9	*	7	18.3	*
22	6	20.4	*	8	22.0	*
23	7	19.8	*	9	19.2	*
24	8	19.2	*	10	21.8	*
25	9	20.0	*	11	24.2	*
26	10	21.3	*	12	25.4	*
27	-	-	-	-	-	-
Total			56			2
Left port	5-16	Misaki		6-17	Misaki	
Returned to port		Misaki		6-10	Misaki	

[Table accompanying tract chart, Sagami Maru_7-Continued.

Station No.	Cruise No. 3			Cruise No. 4		
	Date	Surface Water Temperature	Albacore catch (No. of fish)	Date	Surface Water Temperature	Albacore catch (No. of fish)
1	8-26	26.6	*	9-27	26.0	*
2	27	26.4	*	28	22.7	*
3	28	26.5	*	29	21.8	*
4	29	25.7	*	30	20.4	*
5	30	24.5	*	10- 1	17.0	*
6	31	23.7	*	2	16.8	*
7	9- 1	19.8	*	3	16.5	22
8	2	19.5	0	4	16.7	*
9	3	19.3	*	5	14.3	47
10	4	17.7	2	6	16.3	17
11	5	18.4	3	7	16.7	10
12	6	19.5	0	8	18.6	*
13	7	22.5	2	9	21.4	*
14	8	21.2	0	10	21.5	*
15	9	20.8	1	11	22.6	*
16	10	20.0	0	12	23.3	*
17	11	21.8	*	13	24.5	*
18	12	20.9	1	14	24.4	*
19	13	20.0	0	15	22.9	*
20	14	21.4	*	-	-	-
21	15	21.8	*	-	-	-
22	16	22.6	*	-	-	-
23	17	24.9	*	-	-	-
24	18	24.4	*	-	-	-
25	19	26.4	*	-	-	-
26	20	26.5	*	-	-	-
27	21	27.5	*	-	-	-
Total			9			97
Left port	8-26	Misaki		9-26	Misaki	
Returned to port	7-14	Misaki		10-16	Misaki	

Track chart of Musashi Maru



[Table accompanying tract chart, Musashi Maru]

tation No.	Cruise No. 1			Cruise No. 2		
	Date	Surface Water Temperature	Albacore catch (No. of fish)	Date	Surface Water Temperature	Albacore catch (No. of fish)
1	5-12	18.1	*	6-16	21.2	*
2	13	17.9	*	17	20.9	*
3	14	17.7	*	18	20.5	*
4	15	18.5	*	19	18.3	*
5	16	21.0	*	20	18.0	*
6	17	22.0	*	21	19.2	*
7	18	20.1	0	22	18.5	*
8	19	20.8	*	23	18.8	0
9	20	19.0	0	24	19.0	0
10	21	18.8	*	25	18.3	*
11	22	17.0	8	26	16.4	1
12	23	17.0	236	27	18.5	*
13	24	17.0	-	28	19.0	0
14	25	17.1	*	29	19.3	*
15	26	17.3	*	30	19.3	*
16	27	18.1	0	7- 1	18.9	0
17	28	17.5	0	2	18.9	0
18	29	19.5	0	3	18.9	0
19	30	19.0	0	4	22.0	0
20	31	18.8	0	5	21.2	0
21	6- 1	17.6	*	6	21.3	0
22	2	17.8	*	7	22.0	0
23	3	18.5	*	8	20.3	*
24	4	20.5	*	9	19.1	*
25	5	21.4	*	10	21.5	*
26	6	20.5	*	11	23.6	*
27	7	20.8	*	12	24.5	*
28	8	21.5	*	13	23.9	*
29	-	-	-	14	23.8	*
tal			244			1
ft port	5-11	Misaki		6-15	Misaki	
turned port	6- 9	Misaki		7-14	Misaki	

/Table accompanying tract chart, Musashi Maru_7 -Continued

Station No.	Cruise No. 3			Cruise No. 4		
	Date	Surface Water Temperature	Albacore catch (No. of fish)	Date	Surface Water Temperature	Albacore catch (No. of fish)
1	7-25	25.6	*	8-30	26.7	*
2	26	24.4	*	31	25.8	*
3	27	24.2	*	9- 1	25.3	*
4	28	23.0	*	2	23.0	*
5	29	21.8	*	3	23.0	*
6	30	21.0	0	4	20.4	*
7	31	19.0	*	5	19.4	*
8	8- 1	13.5	0	6	17.0	1
9	2	19.0	0	7	17.4	0
10	3	20.7	1	8	17.5	*
11	4	20.5	0	9	17.5	0
12	5	21.0	0	10	16.5	0
13	6	22.5	*	11	17.0	0
14	7	15.0	0	12	16.5	0
15	8	23.2	0	13	16.5	0
16	9	23.3	0	14	15.5	1
17	10	23.2	0	15	19.0	*
18	11	24.1	*	16	19.8	0
19	12	24.0	*	17	20.8	0
20	13	24.5	*	18	22.0	*
21	14	25.2	*	19	23.0	*
22	15	23.4	*	20	25.2	*
23	16	25.2	*	21	24.5	*
24	17	25.2	*	22	24.8	*
25	18	25.2	*	23	25.5	*
26	19	26.4	*	24	25.2	*
27	-	-	-	25	26.0	*
28	-	-	-	26	25.4	*
29	-	-	-	27	25.8	*
Total			1			2
Left port	7-22	Misaki		8-29	Misaki	
Returned to port	8-20	Misaki		9-28	Misaki	

(3) Results of Operations of Vessels of Each Participating Prefecture

Operations reports submitted in accordance with Form No.2 (C) of the Particulars of the Granting of Subsidies for the Development of Albacore Fishing Grounds are as follows:

Aichi Prefecture

1. Vessel - Shiratori Maru
2. Type of operations - Exploration of albacore fishing grounds
3. Outline of operations

Work on the hull and engine of this vessel was completed in April, 1939, and the construction of fishing gear was begun on May 3. On the 11th the vessel departed Miya Harbor and put in at Shimizu to correct the compass error and to take on some fishing supplies. On the 14th the vessel put in at Misaki and loaded bait, ice, and fresh water. With all preparations for the survey completed the operations described below were begun. In the trips to and from the fishing grounds Great Circle courses were always followed in order to cut down expenses.

First Cruise

The vessel sailed from Misaki on the morning of May 16 and headed for the fishing grounds. On May 27 the assigned operating area was reached and as oceanographic observations indicated a favorable fishing ground, fishing was commenced at once. As was expected, the fishing proved to be good and the vessel fished continuously for 17 operations, selecting suitable water zones in the vicinity. On June 12 the vessel headed back to port with a full load. Arriving at Misaki at 7:00 A.M. June 23, approximately three-fifths of the catch was landed and sold immediately, the rest of it being disposed of the following day. As is shown in Operations Summary Table (1), the value of the fish landed was ¥ 8,665.54.

On this cruise on the way to the fishing grounds a large school of skipjack was seen on May 17 about 170 miles east of Inubōzaki in a water temperature of 20.3°. On the 18th four albacore were taken on the trolling lines in water of 15.6°. On the 19th five albacore were taken in water of 14.5-17°, and on the 20th nine were taken in water temperatures of 16.9-17.5°.

Water temperatures on the fishing grounds ranged from 16.5° to 19.5°, for an average of about 17.7°. The sea was generally calm and the fishing was good.

Since on this cruise there were good prospects of getting a full load right from the start, only the fins (and 16 skins) of most of the sharks [Galeus glaucus] were taken. In order to save space for fish stowage in the latter part of the cruise some of the sharks were kept in iced brine.

Second Cruise

The vessel sailed from Miya Harbor at 3:30 P.M. on July 1. At 8:00 A.M. on the 2nd it put in at Misaki and immediately made all preparations for fishing. On July 5 loading was completed and at noon the vessel sailed from Misaki and headed directly for the fishing grounds. The assigned area was reached on July 16 and the survey was begun immediately. The water temperatures were felt to be rather high and the vessel gradually proceeded to the north and east. By July 31 the easternmost edge of the area was reached, but since the date for the carrying out of the simultaneous oceanographic observations in the North Pacific was approaching, the investigations were temporarily suspended and the vessel headed for home. Strong westerly winds continuing day after day delayed the return, and the vessel arrived at Misaki at 11:00 P.M. on August 14. The market was not open on the following day so the catch was landed and sold on the 16th. As is shown in Operations Summary Table (1), the value of the fish landed was ¥ 3,639.92.

On the way to the fishing grounds on this cruise the trolling lines took two skipjack on July 9 in water of 19.5° temperature. On the 12th in water of 19.5° skipjack were hooked three or four times, but the vessel was proceeding at high speed and they all got off the hook. On the fishing grounds the temperatures during this cruise were at first from 19.5° to 21°, but as operations were gradually shifted to the northeast temperatures of 15.5° to 18.7° were encountered. The sea was generally calm and when the atmospheric temperature was between 16° and 18° there was a great deal of dense fog.

After the completion of this cruise work was begun on the oceanographic observations. Observations 300 miles south of Honshū were completed on August 29.

It was decided to continue the survey from the point where it had been left off on the preceding cruise.

Third Cruise

The vessel sailed from Miya Harbor at 4:00 P.M. on September 3, and arrived at Misaki at 10:00 A.M. the following day. All preparations for fishing were made at once. On September 6 at noon the vessel sailed from Misaki and headed directly for the fishing grounds. On September 13 the lines were set in Area III at 164° 27' E, 44° 44'N. On the next day the lines were set about 50 miles farther east. In the two days of fishing 175 albacore and some other fish were taken, showing how promising Area III was. Operations were suspended here and the vessel moved east to Area II where on September 18 lines were set at 173° 41'E, 44° 16'N. On the following day the vessel shifted its position to the northeast about 70 miles and set lines again. The two days of fishing produced a catch of 154 albacore as well as other fish. Operations in Area II were then temporarily suspended and the vessel proceeded farther to the eastward, reaching Area I on September 21. Operations were carried on for 12 days until October 2, but a good deal of difficulty was encountered because of the continuous

stormy weather and an insufficiency of hands. However, 1,497 albacore were taken. Because of the storms, on October 3 the vessel headed back again to Area II, proceeding to an area south of that fished previously. Lines were set on the 4th at 175° 43'W, 42°, 14'N. and again on the 5th about 100 miles west of that position. In the two days 175 albacore as well as other fish were taken. Because of a lack of bait, the vessel headed homeward, arrival at Misaki being scheduled for October 17, but one day was spent in avoiding a typhoon and the vessel did not reach port until 1:00 P.M. on the 18th. The catch was landed and sold, bringing ¥ 6,611.10.

On this cruise a particular effort was made to ascertain the value of the fishing grounds in Areas II and III. Zones of suitable water were selected and two trials were run in Area III, while a total of four tests on two occasions were made in Area II. From these six trials it was possible to determine the promising character of these grounds.

Water temperatures on the fishing grounds were generally low, being from 15° to 17.5°. It was the season of changing water temperature, and lines of discontinuity were found everywhere, however, there was a good deal of stormy weather which stirred up the surface water so that the zones of suitable water were often lost resulting in difficulties in operation.

Between the departure from Misaki and the arrival in Area III a large school of skipjack was sighted on September 8 in water of 25.5° temperature. Later on September 12 the trolling lines took 16 albacore from water of 18.2° to 16.5° temperature.

4. Conditions on the fishing grounds

(a) Currents

On the first cruise the currents on the fishing grounds were generally northerly and ranged in speed from a maximum of 0.8 miles per hour to almost imperceptible. Southerly currents were encountered once, easterly currents three times, southeast currents twice, northeast currents five times, a west current once, a northwest current once, and a northerly current four times. On the second cruise the currents were generally easterly with a range in velocity from a maximum of about 1 knot to almost imperceptible. Southeast currents were encountered four times, northeast currents twice, and the rest were all easterly. On the third cruise the first operation in Area III was carried out in an easterly current of 0.35 knot velocity, while the second was made in an almost imperceptible easterly current. All four trials in Area II were fished in easterly currents ranging in velocity from a maximum of 0.75 knot to almost imperceptible. On the fishing grounds of Area I the currents were confused. A northwest current was encountered once, northeast currents twice, easterly currents six times, southeast currents six times, a south current once, and a southwest current once. Maximum velocities of 0.5 knot and minimum velocities of 0.3 knot were observed. (See Figure 2)

(b) Water temperature, specific gravity, and water color

The specific gravities and water colors observed on the fishing grounds are shown in Table 3. Where the water temperatures were generally high, large fish were taken, and where the temperatures were low the fish caught were of small size. It can be perceived from the results of last year's survey and from Table 10 of the present report that the highest catch ratios are had where there is little difference between the water temperatures at the surface and at 50 meters and where the temperature drops rapidly below 100 meters.

As in the previous year's survey, the specific gravities were slightly lower at the surface, and were generally favorable all over the fishing grounds.

The water color was determined by the use of Forel's standard fluid, but this was hardly adequate to express the color of the water on the fishing grounds. The water colors were in general as shown in the table; on all cruises the fishing was good where the water showed a whitish cast.

5. Fish schools and signs of life at sea, relation between bait-taking and the condition of the schools, and relations between weather and currents and bait-taking by the schools

(a) Schools and signs of life at sea

On all three cruises there were many signs of life on the fishing grounds. Large and small birds were always seen while steaming and everywhere the lines were set large numbers of birds gathered around the vessel. At their most abundant there were over one hundred birds present, and in general the fishing was best where the birds were most plentiful. This phenomenon shows a point of difference from the conditions encountered last year.

Not one school of albacore was seen on any of the cruises. While outward bound on the first cruise a number of albacore were taken by trolling before entering Area III, and one was taken on June 24 at the boundary between Areas II and III. Two more were taken in Area II on the 25th. On the second cruise no fish were taken by trolling on the trip out, but on the way back one was taken on August 2 on the boundary between Areas II and III. There were generally more signs of life in and over the sea in Areas II and III than in Area I.

On the day before reaching Area III on the third cruise a great many birds were present and many albacore bit on the trolling lines, but the vessel was traveling at such high speed that most of the fish had the hooks torn out of their mouths and got away. Sixteen fish were finally boated.

In Areas II and III sea birds were abundant and were always following in the wake of the vessel, their number sometimes increasing to several score. Birds appeared to be somewhat less abundant in Area I.

(b) Relation between weather and currents and bait-taking

Bait-taking appeared to be generally good on days when the waves were high, and when the rise and fall of the atmospheric pressure was gradual. Good fishing grounds were found in the vicinity of lines of discontinuity, but fish were taken most abundantly where warm water zones penetrated deeply into cold water zones rather than where cold water penetrated into warm zones.

6. Methods of holding bait and the relationship between bait-taking and the freshness of bait

Bait used in these operations was frozen surumeika [Ommastrephes sloani pacificus], frozen mackerel, and salted sardines. The frozen baits were held by operating the refrigerator sufficiently to keep them cold, and the salted bait was held in the ice-hold.

A comparison of the catch made with squid and mackerel on the large hooks shows that for big-eyed tuna, broadbill swordfish, murosame [Isurus glaucus ?], and Lampris regia the mackerel is far superior. For albacore and Galeus glaucus the squid were more effective, as is shown in Table 4.

Data on bait is shown below. [This table is omitted from the translation]

7. Sizes of largest and smallest albacore taken, and number of fish, average size of fish, and type of school of largest catch.

The average weights of albacore are as shown in Table 5. The catch of the first cruise showed the highest average with 11.165 kg, the third cruise was next with 9.266 kg, and the second cruise had the smallest average with 6.938 kg. As the figure shows, on all three cruises the fish taken on the large hooks were the largest, particularly those taken on the center or No.6 hook, which hangs deepest in the water, but it is a strange phenomenon and one worthy of study that of the fish taken on the small hooks the largest were caught on the branch lines nearest the floats. The catch from the first cruise showed the least variation in the size of the fish, and the second cruise showed the greatest irregularity in the distribution of the various sizes of fish among the several branch lines. In this respect the third cruise was intermediate between the other two.

The largest and the smallest fish taken are shown in Table 6. On the first cruise the largest was a 24.375 kg specimen taken on the fourth day, that is at Station D, and the smallest, weighing 3.188 kg, was taken on the ninth day at Station I. On the second cruise a fish weighing 21.0 kg taken on the seventh day at Station X was the largest, while the smallest was one caught on the third day at Station T which weighed 1.688 kg, a small size rarely seen. On the third cruise there were many small fish in Areas II and III. The smallest taken was one from Station JJ in Area II which weighed

2.05 kg, while the smallest caught in Area I was a 2.25 kg specimen from Station MM. The largest fish taken on this cruise was one from Station PP which weighed 21.0 kg, the same weight as the largest fish of the second cruise. On the first cruise few small albacore of 2 to 5 kg weight were taken, but on the second and third cruises a dozen or so small ones were taken every day.

Ordinarily the higher the water temperature the larger the fish and contrariwise when the water temperature was lower, smaller fish were taken, however, this depended on the season. On the third cruise the average water temperature was lower than on the second cruise, nevertheless larger fish were taken. Ordinarily when the largest catches were made the variation in the size of the fish was at a minimum, whereas when the catch was small there was great variation in the sizes of the fish.

A consideration of these facts seems to indicate that the fish in the heart of the fishing ground are all of a size while those strung out ahead and behind on the course of movement are not. Furthermore it appears that at the time of the second cruise the albacore were moving swiftly because of sudden fluctuations in the water temperature and consequently it was extremely difficult to arrive at the heart of the fishing ground.

8. Handling and preservation of the catch

Large fish such as big-eyed tuna and broadbill swordfish were cut open immediately after capture and the gills and viscera were removed. Albacore were not cut but were washed thoroughly in sea water, wrapped individually in cotton cloth, and packed in ice. Sharks were eviscerated, washed, and then iced. The refrigeration machinery was operated enough to keep the ice in the fish-holds from melting. On the first cruise the prospects of a full load were good right from the start and consequently only the fins were taken from the sharks and most of the carcasses were thrown overboard in order to save space for albacore. However, in the latter part of the cruise in order to increase the space for fish stowage, all of the catch except Galeus glaucus was kept in iced brine. Ice was not used in half of this brine, but the sea water was brought down to below 0°, the catch was put into it and it was then held at about one degree below zero. Skins from sixteen of the discarded sharks were salted down and brought back.

9. Place sold, method of sale, and price

All of the catch was sold at Misaki in Kanagawa Prefecture. Sales were by written bid in the fish market, just like those of ordinary fishing boats. Prices, commissions, and profits are shown in the table.

10. Summary of Results of Operations

A summary of the results of operations is as shown in Table 1.

11. Summary observations on fishing boats, gear, methods, grounds, and seasons

(a) Fishing Boat

A vessel like the guide boat of this Station is satisfactory, but judging by the experience of this year and last year live-bait wells are not necessary and the ideal vessel would be a specialized longline type with additional fish-holds. The ice and fish capacity should be increased as much as possible.

(b) Fishing Gear

The gear used this year was ordinary tuna longlines of the type employed in the winter season. They differed from those used last year in that sekiyama was used on the small hook branches as well as the large ones and in the length of the float lines, which was eighteen fathoms. In other respects they were about the same as the gear used in the previous year's operations. Also in this year's investigations a part of the gear was made of New Zealand hemp, which had been in use since the previous autumn, in place of cotton line. No difference was detected in the catch ratios obtained with these two sorts of line, but there was some difference in the ease of handling. It was thought, however, that this was due to the fact that the method of manufacture was somewhat unsatisfactory, and therefore if this is improved or the line is made by more experienced workers it should be possible to eliminate these defects completely. Furthermore it was found that this line is superior in tensile strength to the cotton line which has been used for the same purposes, a truly important discovery in view of the prevailing conditions of supply.

As is clearly shown in Table 7, which gives the catch ratios of the various branch lines and the value of the catch of each hook, the deeper the hooks the better the fish bit. The catch on the small hooks of the central portion of the line was much better than that of the large hooks. If the big hooks were taken off and replaced with small ones there would be a saving on bait of about ¥ 2,800 and an increase in the value of the catch of about ¥ 500. If the length of the float lines were suitably adjusted, it is thought that the gear would be even more effective.

If we consider the catch ratios in relation to the size of the hooks, on all three cruises the fish taken on the large hooks were bigger than those taken on the small ones, but there were 23 per cent fewer of them. This gives one the feeling that the hooks were too large for the fish's mouths, but it should be noted as an exception that on the third cruise albacore of around 3 to 9 kg weight were taken every day on the large hooks while on the other hand the small hooks caught rather large albacore and sharks. In view of these facts it appears that the size of the hooks is not a great problem.

(c) Fishing Method

The experience of this year and the preceding year indicates that long-lines are the only method for catching albacore in pelagic waters. It is

thought that almost nothing can be expected from the use of pole fishing and trolling methods.

As was also reported in last year's report, it is thought that better results can be obtained in the future by adopting the mothership system for operations in Area I because, this area being the farthest from the base, a great deal of time and money are consumed in going to and from the grounds and the operating efficiency for the whole season is thereby lowered. The above conclusions were reached after operating nothing but longlines every day on the fishing grounds and using only one or two trolling lines on the way to and from the operating area, but naturally if large schools of fish were discovered in the surface layer, whichever of these methods would produce the biggest catch would be selected.

(d) Fishing Grounds, Fishing Seasons

From the results of this investigation it appears that during the summer the designated area of the albacore grounds should on the whole be shifted somewhat to the north. At the beginning of the season the grounds were in areas having surface water temperatures of around 18°, that is in the vicinity of 34-35° north latitude, while at the end of the season they were in areas having surface temperatures of around 16° in the vicinity of 44-46° north latitude. Thus it appears that the suitable water temperature changes regularly with the season. The fishing grounds of the first cruise can be considered to have been in zones of water temperatures suitable for the season. When, on the third cruise, the vessel was following the lines of discontinuity at the northernmost extremes of Areas II and III, it appeared that there were suitable water zones even farther north; the first half of the operations in Area I seem to have been fairly near the center of a suitable water zone. On the first cruise the fishing grounds appear to have been roughly at the center of a group of schools in motion, but the second cruise was at the season when the schools are moving fastest and it is most difficult to discover their center. Consequently the concentration of the schools was sparse and the fish were not of uniform size. On the third cruise, as was noted above, the first half of the operations was near the center, apparently somewhat to the south, but at the end of the cruise the schools appeared to have changed their direction of migration and headed south again.

This year the vessel was absent from the fishing grounds for about 50 days due to its participation in the North Pacific Simultaneous Oceanographic Observations between the second and third cruises, and consequently it was not possible to gain a detailed knowledge of the movements of the schools. If these investigations were carried on continuously or in relays it is believed that they would be even more effective.

12. Other particulars considered essential

(a) Ecological Investigations

The results of the ecological observations are shown in Table 8. In studies of the stomach contents small squids, Euphausia sp. (including Stylocheiron carinatus), Isopoda sp., Anisopoda sp., Carinaria sp., and small

fishes were found. On all cruises these same items were found in large numbers in the stomachs of Galeus glaucus and Plagiodus ferox showing that food is rather abundant in the North Central Pacific.

From the averages for each voyage of the relationships between the length, circumference, and weight of the fish it was found that on the first cruise the females had greater weight for their length. On the second cruise this value was greater for the males and on the third cruise it was slightly greater for the males. The average weight of the fish was greatest on the first cruise followed by the third and second in that order. It appeared that with small fish the males were heavier in relation to their length while with larger fish the females showed a higher weight-length value. There was no great variation in the ratio of weight to girth and it appeared that there is after all only a certain amount of difference due to the form of the fish.

(b) Plankton Investigations

Although a standard quantity plankton net had been ordered the previous year for use in this investigation, it was not ready in time to be used on the first and second cruises. The net was finally employed on the third cruise, but because of the delay the quantitative study was abandoned and only the species were investigated. It was found, however, that in general plankton was present in the greatest quantity on the third cruise. As Table 9 shows, more species were collected than in the previous year, particularly of diatoms. On all three cruises warm water and cold water forms as well as those which appear in both warm and cold water were included in the hauls, and they evidenced the fact that the best fishing grounds are found at lines of discontinuity where warm and cold waters are mingled.

(c) Sexing Albacore and a Swimming Habit

Those fish which immediately after capture had bright shiny eyes, somewhat rounded tips on their pectoral fins, and fusiform bellies were mostly males, while those which had rather dull eyes, sharply pointed pectorals, and rounded bellies were for the most part females, however, it was difficult to distinguish the sexes accurately. Seventy or eighty per cent of the fish were hooked in the left cheek, indicating that they circle to the right in feeding. It is wondered whether sardines may not generally have the habit of circling to the right.

(d) Investigation of the Number of Live and Dead Fish

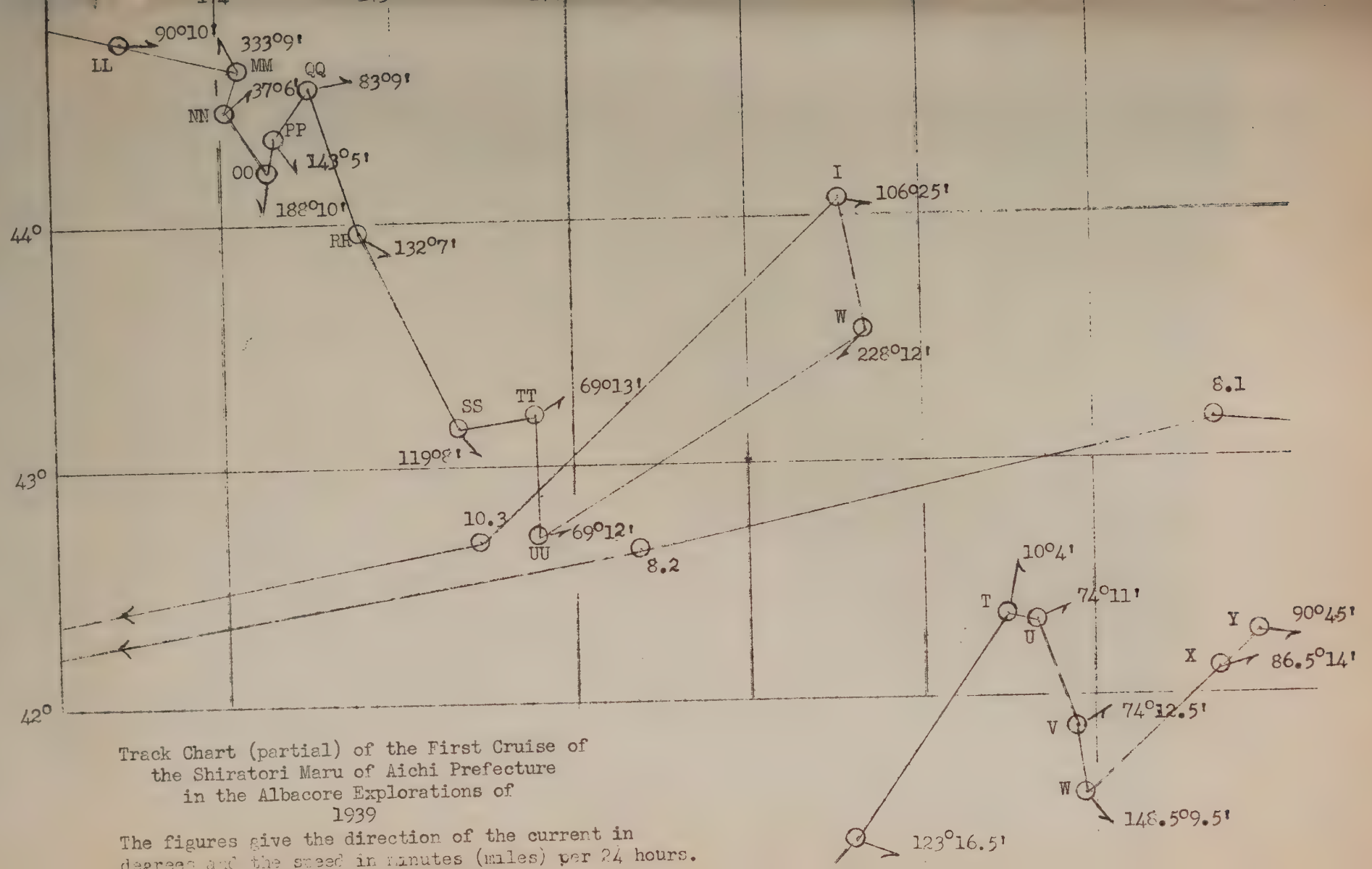
Records were kept throughout this operation on whether the albacore were alive or dead when the lines were hauled in. On all branch lines live fish predominated, but the actual and proportional figures for each cruise and for each branch are given in the following table.

[A table of participating personnel, a Summary Table of the Results of Operations (see Table 4, column 1), and a Table of the Results of Operations by Cruises (see Table 5) have been omitted at this point. After the "Table of the Weights of Albacore Taken at Each Station" a graph showing the

money value of the catch of each branch line has been omitted. Following the "Table of the Ecological Study of Albacore", a set of tables showing the average measurements of the albacore taken at each station has been omitted. Then a table of the plankton collected, and a graph of the relationship of albacore catch to water temperature and specific gravity have been left out, the latter because of the impossibility of tracing it accurately from the microfilm. A set of tables entitled "Table of the Results of Explorations of Albacore Fishing Grounds, 1939, Aichi Prefecture, Shiratori Maru" was eliminated because the information in it is summarized in the earlier Tables 4 and 5_/

/ Numbers and Percentages of Albacore Found Dead and Alive on Each Branch Line /

Branch Number			No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	unknown	Total
First Cruise	Number	Alive	154	183	49	338	306	84	303	223	64	181	128	18	3,173
		Dead	110	140	45	143	138	47	157	119	33	108	86	16	
	Percent	Alive	0.58	0.57	0.52	0.70	0.69	0.64	0.66	0.65	0.66	0.63	0.60	0.53	
		Dead	0.42	0.43	0.48	0.30	0.31	0.36	0.34	0.35	0.34	0.37	0.40	0.47	
Second Cruise	Number	Alive	43	64	15	84	90	23	72	63	7	47	48	8	1,219
		Dead	24	52	12	141	105	31	104	85	13	59	29	0	
	Percent	Alive	0.64	0.55	0.56	0.37	0.46	0.43	0.41	0.43	0.35	0.44	0.62	1.00	
		Dead	0.36	0.45	0.44	0.63	0.54	0.57	0.59	0.57	0.65	0.56	0.38		
Third Cruise	Number	Alive	102	137	47	160	155	58	146	134	47	128	83	31	2,008
		Dead	47	50	36	102	128	28	141	113	25	62	42	10	
	Percent	Alive	0.68	0.68	0.57	0.60	0.56	0.67	0.51	0.54	0.65	0.66	0.66	0.76	
		Dead	0.32	0.32	0.43	0.40	0.44	0.43	0.49	0.46	0.45	0.44	0.44	0.24	
Total	Number	Alive	299	384	111	582	551	165	521	420	118	350	259	57	6,400
		Dead	183	242	93	392	365	106	402	317	71	229	157	26	
		Total	482	626	204	974	916	271	923	737	189	579	416	83	
	Percent	Alive	0.51	0.61	0.59	0.60	0.60	0.61	0.56	0.57	0.62	0.60	0.62	0.69	
		Dead	0.49	0.39	0.41	0.40	0.40	0.39	0.44	0.43	0.38	0.40	0.38	0.31	



Track Chart (partial) of the First Cruise of the Shiratori Maru of Aichi Prefecture in the Albacore Explorations of 1939

The figures give the direction of the current in degrees and the speed in minutes (miles) per 24 hours.

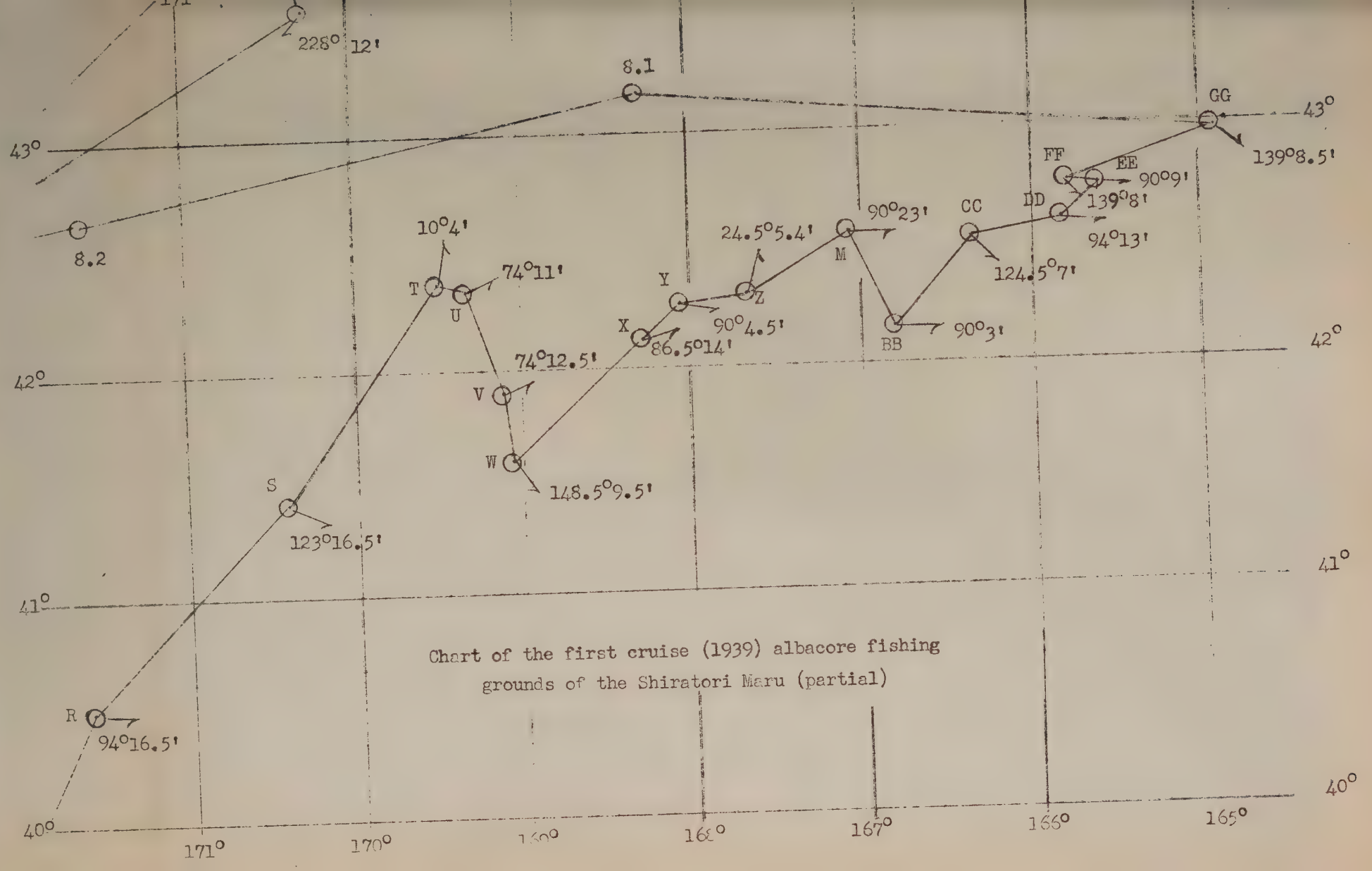
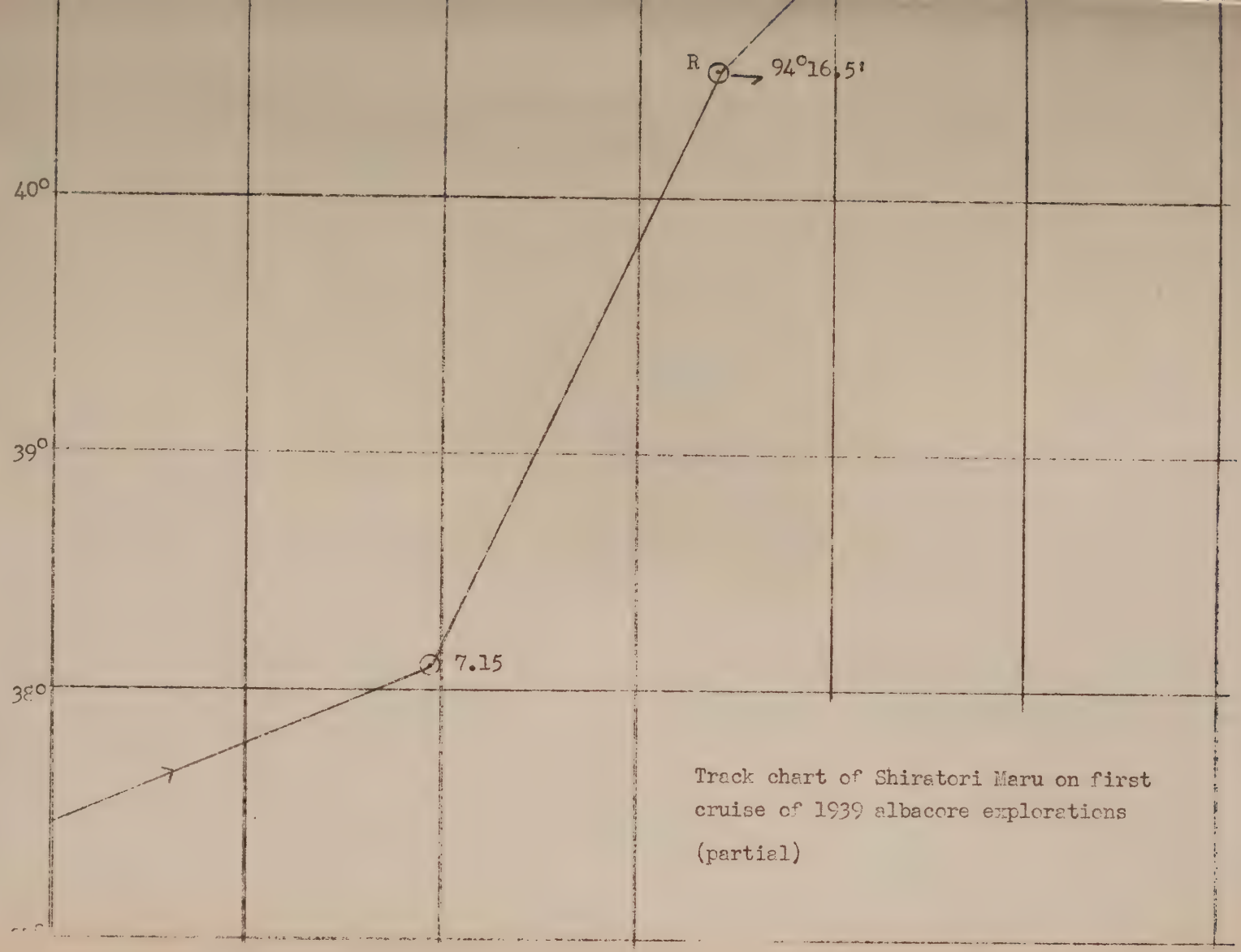


Chart of the first cruise (1939) albacore fishing grounds of the Shiratori Maru (partial)



Track chart of Shiratori Maru on first cruise of 1939 albacore explorations (partial)

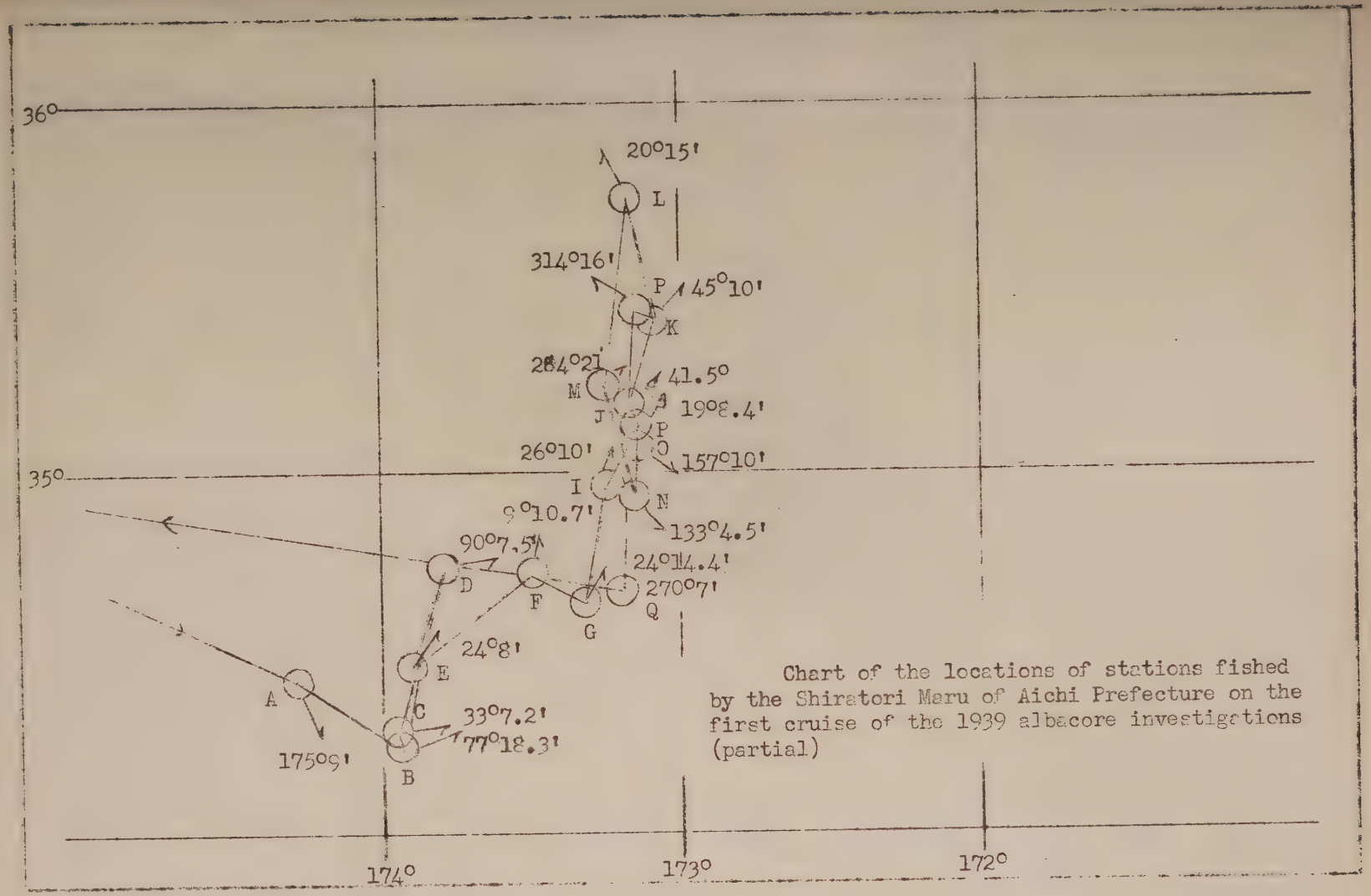


Chart of the locations of stations fished by the Shiratori Maru of Aichi Prefecture on the first cruise of the 1939 albacore investigations (partial)

Oceanographic and Catch Data - Shiratori Maru - First Cruise (Part 1)

Date	Station	Time of Observation	Atmospheric Pressure	Atmospheric Temperature	Weather Cloud Cover	Wind Direction Wind Force
5-27	A	0834	754.0	20.0°	C 9	WSW 4
28	B	0834	754.0	20.0	C 9	WSW 4
29	C	0855	765.5	19.2	B 3	N 1
30	D	0825	765.5	19.2	R 10	SW 1
31	E	0540	764.0	17.0	R 10	N 3
6- 1	F	0550	762.5	17.5	C 7	E 2
2	G	—	750.0	20.0	R 10	SW 6
3	H	1010	753.5	17.8	BC 7	SW 4
4	I	0920	758.5	18.2	BC 7	SW 7
5	J	1017	763.0	19.2	B 3	WSW 3
6	K	0840	760.5	19.0	R 10	SSE 2
7	L	0910	757.0	20.5	C 8	W 3
8	M	0625	759.5	18.0	C 7	NNE 1
9	N	0842	761.5	18.0	C 7	NNW 1
10	O	0810	762.0	17.0	C 8	N 1
11	P	0528	761.5	17.0	BC 5	NE 3
12	Q	0835	756.0	18.0	C 10	NE 5

3 Oceanographic and Catch Data - Shiratori Maru - First Cruise (Part 2)

Date	Station	Water Temperature				Specific Gravity				Water Color	Transparency
		0m	50m	100m	200m	0m	50m	100m	200m		
5-27	A	17.7°	15.5°	14.5°	13.5°	25.693	25.762	26.235	25.554	2	18.0m
28	B	17.7	15.5	14.5	13.5	25.832	25.943	25.762	25.832	2	25.0
29	C	18.6	16.2	14.6	13.7	25.832	25.901	25.832	25.624	2	25.0
30	D	17.8	16.5	14.6	13.5	25.554	25.832	25.901	25.693	2	27.0
31	E	18.1	16.4	15.5	13.4	25.554	25.901	25.762	25.693	2	23.0
6- 1	F	18.5	16.1	15.0	13.5	25.832	25.832	25.762	25.762	2	27.0
2	G	18.3	—	—	—	—	—	—	—	-	—
3	H	17.6	15.8	15.0	14.4	25.762	25.901	25.832	25.693	2	20.0
4	I	18.2	16.0	14.8	14.0	25.693	25.901	25.832	25.762	2-3	18.0
5	J	18.1	16.0	15.2	14.4	25.832	26.026	25.901	25.901	2	19.5
6	K	17.6	17.0	16.0	13.8	25.639	25.832	25.693	25.693	2	19.5
7	L	17.6	17.4	15.5	13.9	25.762	25.901	25.832	25.304	2	25.0
8	M	18.2	16.1	15.5	14.5	25.874	26.235	26.374	25.693	2	24.5
9	N	18.0	16.5	15.0	14.0	25.624	25.832	25.971	25.832	2	22.0
10	O	18.2	16.2	14.8	13.8	25.624	25.901	25.901	25.832	2	26.0
11	P	17.8	16.4	15.0	13.8	25.832	25.901	26.374	25.693	2	22.5
12	Q	18.9	16.8	15.2	14.8	25.901	25.971	25.971	25.693	2	24.0

Oceanographic and Catch Data - Shiratori Maru - First Cruise (Part 3)

Date	Station	Catch (numbers of fish)							
		Albacore	Big-eyed	Daruma [?]	Broadbill	L. regia	I. glaucus	G. glaucus	Other
5-27	A	184	1	—	—	—	—	20	—
28	B	290	1	—	—	1	3	20	—
29	C	331	6	—	—	1	—	11	—
30	D	333	3	—	—	1	—	6	—
31	E	446	5	—	—	1	—	19	—
6- 1	F	214	18	—	—	2	—	5	—
2	G	230	19	—	—	—	—	2	—
3	H	64	—	1	—	—	—	3	—
4	I	112	15	—	—	1	2	4	—
5	J	138	9	—	—	1	3	8	—
6	K	173	6	1	—	—	3	19	—
7	L	97	1	—	—	3	—	15	—
8	M	191	5	—	—	3	—	15	—
9	N	201	5	—	—	—	3	16	—
10	O	120	5	—	—	1	1	5	—
11	P	35	—	—	—	1	1	8	—
12	Q	14	10	—	—	—	—	4	—

Oceanographic and Catch Data - Shiretori Maru - Second Cruise (Part 1)

Date	Station	Time of Observation	Atmospheric Pressure	Atmospheric Temperature	Weather Cloud Cover		Wind Direction Wind Force	
7-16	R	0850	772.0	22.2	BC	5	S	1
17	S	0827	772.0	21.5	BC	3	SSW	1
18	T	0852	769.0	21.2	B	3	SW	1
19	U	0855	761.5	19.9	R	10	SW	4
20	V	0848	758.5	19.0	C	7	WNW	3
21	W	0843	760.5	18.0	B	3	WNW	1
22	X	0845	761.5	19.2	C	8	WNW	1
23	Y	0840	763.0	19.5	BC	6	WSW	2
24	Z	0834	765.5	19.0	BC	6	WSW	2
25	AA	0840	764.0	17.5	F		WSW	1
26	BB	0833	764.5	17.8	BC	3	NW	1
27	CC	0840	764.5	19.0	BC	5	WSW	2
28	DD	0830	768.5	19.5	C	8	WSW	1
29	EE	0833	768.0	19.5	F	5	WSW	1
30	FF	0930	769.0	14.0	O	10	N	1
31	GG	0917	768.0	16.0	B	5	SW	1

Oceanographic and Catch Data - Shiratori Maru - Second Cruise (Part 2)

Date	Station	Water Temperature				Specific Gravity				Water Color	Transparency
		0m	50m	100m	200m	0m	50m	100m	200m		
7-16	R	20.3	13.7	12.5	11.8	25.499	25.762	25.693	25.499	—	20.0
17	S	18.7	12.2	10.8	9.9	25.489	25.429	25.429	25.360	—	12.0
18	T	18.8	12.0	11.2	9.9	25.152	25.429	25.360	25.429	—	12.0
19	U	17.2	12.6	10.5	9.0	25.221	25.360	25.429	25.429	—	9.0
20	V	17.7	12.0	11.3	10.1	25.291	25.624	25.499	25.499	—	11.0
21	W	18.0	12.3	10.3	10.0	25.221	25.291	25.082	25.360	—	15.0
22	X	16.7	11.2	10.2	9.5	25.221	25.360	25.221	25.152	—	12.0
23	Y	16.5	11.8	10.2	9.6	25.152	25.221	25.221	25.221	—	13.0
24	Z	17.0	11.5	10.5	9.8	25.152	25.360	25.221	25.291	—	11.0
25	AA	15.8	10.5	9.0	9.0	24.957	25.027	25.027	25.082	—	20.0
26	BB	17.8	11.5	9.8	9.2	24.743	25.027	25.082	25.221	—	14.0
27	CC	17.0	11.5	9.7	9.7	24.749	25.152	25.082	25.221	—	13.0
28	DD	16.9	11.7	9.8	9.5	24.957	25.082	25.360	25.360	—	14.0
29	EE	17.0	10.7	9.6	9.0	24.680	25.624	25.221	25.221	—	14.0
30	FF	17.0	12.0	10.2	9.2	24.888	25.291	25.291	25.499	—	15.0
31	GG	15.7	10.0	9.0	8.5	24.819	24.957	25.027	25.152	—	15.0

Oceanographic and Catch Data - Shiratori Maru - Second Cruise (Part 3)

Date	Station	Catch (numbers of fish)							
		Albacore	Big-eyed	Daruma ?	Broadbill	L.regia	I.glaucus	G.glaucus	Other
7-16	R	15	1	—	—	1	1	3	—
17	S	20	—	—	—	1	—	163	—
18	T	93	3	—	—	—	1	38	—
19	U	50	2	—	—	1	1	44	—
20	V	100	—	—	—	2	—	52	—
21	W	106	2	—	—	1	—	44	—
22	X	57	1	—	—	—	4	41	1 thresher
23	Y	67	2	—	—	—	2	36	—
24	Z	107	—	—	—	1	1	38	—
25	AA	81	—	—	1	—	—	68	—
26	BB	82	—	—	—	—	—	47	—
27	CC	94	—	—	—	1	1	50	—
28	DD	100	1	—	—	—	—	48	—
29	EE	96	2	—	—	—	—	23	—
30	FF	81	—	—	—	1	—	29	—
31	GG	70	—	—	—	—	1	12	—

Oceanographic and Catch Data - Shiratori Maru - Third Cruise (Part 1)

Date	Station	Time of Observation	Atmospheric Pressure	Atmospheric Temperature	Weather Cloud Cover		Wind Direction Wind Force	
9-13	HH	0730	755.5	17.0	CF	8	NW	1
14	II	0730	755.8	17.8	CF		SSE	3
18	JJ	0700	767.0	15.2	C	8	NNW	1
19	KK	0700	764.5	15.0	C	8	NNW	3
21	LL	0730	757.0	14.0	C	8	NNW	1
22	MM	0730	744.0	15.5	'	8	ESE	3
23	NN	0700	740.5	13.0	C	9	NNE	5
24	OO	0730	740.7	14.2	C	8	W	5
25	PP	0730	749.5	15.5	BC	6	NNW	4
26	QQ	0800	752.5	17.5	BC	4	SSW	3
27	RR	0800	754.5	15.0	C	8	W	6
28	SS	0730	763.5	15.0	C	8	NW	2
29	TT	0730	761.5	16.0	R	10	SSW	3
30	UU	0730	749.5	18.8	R	10	SSW	5
10-1	VV	0730	745.5	16.5	BC	6	SW	2
2	1	0730	756.0	15.0	C	8	NNE	5
4	2	—	750.5	18.0	B	2	SE	2
5	3	—	748.5	16.7	R	10	NW	3

Oceanographic and Catch Data - Shiratori Maru - Third Cruise (Part 2)

Date	Station	Water Temperature				Specific Gravity				Water Color	Transparency
		0m	50m	100m	200m	0m	50m	100m	200m		
9-13	HH	16.5	10.3	9.7	9.1	—	—	—	—	3	15.0
14	II	15.8	7.5	5.5	5.7	—	—	—	—	3	16.5
18	JJ	16.3	11.9	8.0	6.0	—	—	—	—	2	16.0
19	KK	16.4	11.4	8.0	6.0	—	—	—	—	2-3	13.0
21	LL	15.9	9.0	7.9	6.4	—	—	—	—	2	10.5
22	MM	16.3	9.5	8.8	8.8	—	—	—	—	2	14.5
23	NN	15.8	9.8	8.5	7.8	—	—	—	—	2	15.0
24	OO	16.3	10.5	9.3	8.4	—	—	—	—	2	14.5
25	PP	15.7	11.8	9.3	8.2	—	—	—	—	3	12.0
26	QQ	14.5	10.8	8.9	8.0	—	—	—	—	3	15.0
27	RR	15.5	11.4	9.3	8.7	—	—	—	—	3	15.0
28	SS	16.9	11.5	11.0	8.8	—	—	—	—	3	20.0
29	TT	16.0	11.5	9.0	8.8	—	—	—	—	3	11.5
30	UU	17.0	12.0	9.6	9.0	—	—	—	—	2	13.0
10-1	VV	15.9	11.5	10.4	8.6	—	—	—	—	3	11.0
2	1	15.3	11.0	10.0	8.0	—	—	—	—	3	16.0
4	2	16.7	16.4	11.6	9.0	—	—	—	—	3	13.0
5	3	16.7	14.2	12.0	8.7	—	—	—	—	3	17.0

Date	Station	Catch (numbers of fish)							
		Albacore	Big-eyed	Daruma	Broadbill	L.regia	I.glaucus	G.glaucus	Other
9-13	HH	93	—	—	—	9	—	10	—
14	II	82	—	—	2	10	—	1	—
18	JJ	87	—	—	—	5	—	7	—
19	KK	67	—	—	—	2	—	—	—
21	LL	101	—	—	—	—	—	17	—
22	MM	281	—	—	—	—	1	18	—
23	NN	104	1	—	—	—	—	4	—
24	OO	165	—	—	—	—	—	8	—
25	PP	229	2	—	—	—	2	23	—
26	QQ	126	—	—	—	—	—	6	—
27	RR	86	—	—	—	—	1	9	—
28	SS	147	—	—	1	1	—	18	—
29	TT	103	—	—	—	1	—	7	—
30	UU	40	—	—	—	—	—	2	—
10-1	VV	55	—	—	—	—	1	9	—
2	1	60	—	—	—	—	1	3	—
4	2	125	—	—	—	—	—	16	—
5	3	54	—	—	—	1	1	10	—

Notes to the table of oceanographical and catch data of the Shiratori Maru.

1. At Station G on the first cruise, observations could not be taken because of stormy weather.

2. On the third cruise it was impossible to make specific gravity determinations because on the way back to port the vessel encountered a typhoon and in the high seas which resulted the sea water bottles were broken.

Table of Catch by Branch Lines and Types of Bait - Shiratori Maru - First Cruise

Branch Line No.	Albacore	Big-eyed	Sardines: *I. glaucus*	Thresher	*G. glaucus*	*L. regia*
1	264	12	1	—	8	—
2	323	7	—	—	6	1
3	—	—	—	—	—	—
4	481	3	1	—	3	—
5	444	4	2	—	4	—
6	—	—	—	—	—	—
7	460	4	—	—	—	—
8	342	2	1	—	2	—
9	—	—	—	—	—	—
10	289	7	—	—	1	—
11	214	5	—	—	—	—
unknown	34	11	3	—	16	1
Total	2,851	55	8	—	40	2

Table of Catch by Branch Lines and Types of Bait - Shiratori Maru - First Cruise (Part 2)

Branch Line No.	Squid						
	Albacore	Big-eyed	Broadbill	I. glaucus	I. nasus	L. regia	G. glaucus
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	71	8	—	—	—	—	18
4	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—
6	83	10	—	2	—	—	36
7	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—
9	71	7	—	—	—	2	21
10	—	—	—	—	—	—	—
11	—	—	—	—	—	—	—
unknown	—	—	—	—	—	—	—
Total	225	25	—	2	—	2	75

Table of Catch by Branch Lines and Types of Bait - Shiratori Maru - First Cruise (Part 3)

Branch Line No.	Mackerel					
	Albacore	Big-eyed	Broadbill	I. glaucus	L. regia	G. glaucus
1	—	—	—	—	—	—
2	—	—	—	—	—	—
3	23	17	—	1	5	17
4	—	—	—	—	—	—
5	—	—	—	—	—	—
6	48	10	—	4	5	19
7	—	—	—	—	—	—
8	—	—	—	—	—	—
9	26	15	—	1	2	24
10	—	—	—	—	—	—
11	—	—	—	—	—	—
unknown	—	—	—	—	—	—
Total	97	42	—	6	12	60

Table of Catch by Branch Lines and Types of Bait - Shiratori Maru - First Cruise (Part 4)

Totals

Branch Line No.	Albacore	Big-eyed	Broadbill	I. glaucus	Thresher	I. nasus	L. regia	G. glaucus
1	264	12	—	1	—	—	—	8
2	323	7	—	—	—	—	1	6
3	94	25	—	1	—	—	5	35
4	481	3	—	1	—	—	—	3
5	444	4	—	2	—	—	—	4
6	131	20	—	6	—	—	5	55
7	460	4	—	—	—	—	—	—
8	342	2	—	1	—	—	—	2
9	97	22	—	1	—	—	4	45
10	289	7	—	—	—	—	—	1
11	214	5	—	—	—	—	—	—
unknown	34	11	—	3	—	—	1	16
Total	3,173	122	—	16	—	—	16	175

Table of Catch by Branch Lines and Types of Bait - Shiratori Maru - Second Cruise (Part 1)

Branch Line No.	Albacore	Sardines: Big-eyed	Sardines: I. glaucus	Thresher	Sardines: G. glaucus	Sardines: L. regia
1	67	—	1	—	99	—
2	116	—	—	—	44	—
3	—	—	—	—	—	—
4	225	—	—	—	35	—
5	195	1	—	—	20	—
6	—	—	—	—	—	—
7	176	—	—	1	19	—
8	148	—	—	—	24	—
9	—	—	—	—	—	—
10	106	—	1	—	40	—
11	77	—	—	—	78	—
unknown	8	2	—	—	—	—
Total	1,118	3	2	1	359	—

Squid

Branch Line No.	Albacore	Big-eyed	Broadbill	I. glaucus	I. nasus	L. regia	G. glaucus
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	14	1	—	3	—	1	83
4	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—
6	31	—	—	2	—	1	62
7	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—
9	14	1	—	1	—	—	81
10	—	—	—	—	—	—	—
11	—	—	—	—	—	—	—
unknown	—	—	—	—	—	—	—
Total	59	2	—	6	—	2	226

Mackerel

Branch Line No.	Albacore	Big-eyed	Broadbill	I. glaucus	L. regia	G. glaucus
1	—	—	—	—	—	—
2	—	—	—	—	—	—
3	13	1	—	2	2	60
4	—	—	—	—	—	—
5	—	—	—	—	—	—
6	23	5	1	—	3	55
7	—	—	—	—	—	—
8	—	—	—	—	—	—
9	6	3	—	2	2	48
10	—	—	—	—	—	—
11	—	—	—	—	—	—
unknown	—	—	—	—	—	—
Total	42	9	1	4	7	163

Totals

Branch Line No.	Albacore	Big-eyed	Broadbill	I. glaucus	Thresher	I. nasus	L. regia	G. glaucus
1	67	—	—	1	—	—	—	99
2	116	—	—	—	—	—	—	44
3	27	2	—	5	—	—	3	143
4	255	—	—	—	—	—	—	35
5	195	1	—	—	—	—	—	20
6	45	5	1	2	—	—	4	117
7	176	—	—	—	1	—	—	19
8	148	—	—	—	—	—	2	24
9	20	4	—	3	—	—	—	129
10	106	—	—	1	—	—	—	40
11	77	—	—	—	—	—	—	78
unknown	8	2	—	—	—	—	—	—
Totals	1,219	14	1	12	1	—	9	768

Table of Catch by Branch Lines and Types of Bait - Shiratori Maru - Third Cruise (Part 1)

Branch Line No.	Sardines: Albacore	Big-eyed	I. glaucus	Thresher	G. glaucus	L. regia
1	151	—	—	—	3	1
2	187	—	—	—	9	4
3	—	—	—	—	—	—
4	268	—	—	—	1	4
5	277	—	—	—	2	2
6	—	—	—	—	—	—
7	287	—	—	—	7	1
8	247	—	1	—	3	2
9	—	—	—	—	—	—
10	184	—	—	—	14	2
11	125	—	—	—	17	—
unknown	41	2	2	—	21	—
Total	1,767	2	3	—	77	16
Grand Total	5,736	60	13	1	476	18

Table of Catch by Branch Lines and Types of Bait - Shiratori Maru - Third Cruise (Part 2)

Squid

Branch Line No.	Albacore	Big-eyed	Broadbill	I. glaucus	I. nasus	L. regia	G. glaucus
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	53	—	—	—	—	4	15
4	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—
6	46	—	2	—	1	6	22
7	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—
9	46	—	—	—	—	—	—
10	—	—	—	—	—	—	—
11	—	—	—	—	—	—	—
unknown	—	—	—	—	—	—	—
Total	145	—	2	—	1	10	37
Grand Total	429	27	2	8	1	14	338

Table of Catch by Branch Lines and Types of Bait - Shiratori Maru - Third Cruise (Part 3)

Branch Line No.	Mackerel					
	Albacore	Big-eyed	Broadbill	I. glaucus	L. regia	G. glaucus
1	—	—	—	—	—	—
2	—	—	—	—	—	—
3	30	—	—	2	—	12
4	—	—	—	—	—	—
5	—	—	—	—	—	—
6	40	—	1	1	1	16
7	—	—	—	—	—	—
8	—	—	—	—	—	—
9	26	1	—	1	2	26
10	—	—	—	—	—	—
11	—	—	—	—	—	—
unknown	—	—	—	—	—	—
Total	96	1	1	4	3	54
Grand Total	235	52	2	14	22	277

Table of Catch by Branch Lines and Types of Bait - Shiretori Maru - Third Cruise (Part 4)

Totals

Branch Line No.	Albacore	Big-eyed	Broadbill	I. glaucus	Thresher	I. nasus	L. regia	G. glaucus
1	151	—	—	—	—	—	1	3
2	187	—	—	—	—	—	4	9
3	83	—	—	2	—	—	4	27
4	268	—	—	—	—	—	4	1
5	277	—	—	—	—	—	2	2
6	86	—	3	1	—	1	7	38
7	287	—	—	—	—	—	1	7
8	247	—	—	1	—	—	2	3
9	72	1	—	1	—	—	2	26
10	184	—	—	—	—	—	2	14
11	125	—	—	—	—	—	—	17
unknown	41	1	—	2	—	—	—	21
Total	2,008	3	3	7	—	1	29	168
Grand Total	6,400	139	4	35	1	1	54	1,091

Note: Where the branch lines became entangled and it could not be ascertained on which line the fish had been taken for the sake of convenience the catch was entered under the heading "Unknown" in the section for sardine bait

Aver-age	Third Cruise	Second Cruise	First Cruise	Hook No.
9.011 kg	9.169 kg	6.728 kg	11.137 kg	1
8.876	8.933	6.656	11.037	2
9.873	9.795	8.700	11.125	3
9.052	9.195	6.750	11.212	4
8.859	9.169	6.375	11.034	5
10.266	9.949	9.120	11.729	6
9.017	9.240	6.731	11.081	7
9.158	9.438	6.896	11.145	8
9.983	9.745	8.558	11.638	9
9.188	9.311	7.178	11.076	10
9.321	9.285	7.223	11.455	11
9.039	9.056	6.375	11.687	up-knot
9.123	9.266	6.938	11.165	Average

Table of Average Weight of Albacore from Each Branch Line

Table of the Weights of the Albacore Taken at Each Fishing Station (6)

First Cruise

Date	Station	Number of Fish Taken	Weights in Kg			
			Total Weight	Maximum	Minimum	Average
5-27	A	184	1,724.625	15.375	6.000	9.371
5-28	B	290	2,737.666	18.750	6.375	10.301
5-29	C	331	3,802.258	21,375	7.500	11.486
5-30	D	333	3,556.538	24.375	6.375	8.426
5-31	E	446	5,129.115	17.625	6.375	11.501
6-1	F	214	2,525.888	19.885	6.375	11.805
6-2	G	230	2,427.120	13,875	7.500	10.553
6-3	H	64	737.625	17.625	7.500	11.524
6-4	I	112	1,171.694	15.000	3.188	10.637
6-5	J	138	1,404.525	16.125	6.863	10.178
6-6	K	173	1,778.775	21.750	6.750	10.283
6-7	L	97	971.400	16.875	7.125	10.014
6-8	M	191	2,244.563	16.875	7.313	11.753
6-9	N	201	2,710.500	22.500	9.000	13.485
6-10	O	120	1,566.450	17.625	9.000	13.054
6-11	P	35	472.835	15.750	9.375	13.499
6-12	Q	14	195.000	16.875	11.250	13.928
Totals		3,173	35,272.895	24.375	3.188	11.341

Table of the Weights of the Albacore Taken at Each Fishing Station (6)

Second Cruise

Date	Station	Number of Fish Taken	Weights in Kg			
			Total Weight	Maximum	Minimum	Average
7-16	R	15	161.363	15.375	2.363	10.758
7-17	S	20	197.625	11.625	2.625	9.881
7-18	T	93	777.300	13.875	1.688	8.359
7-19	U	50	389.438	13.125	2.625	7.789
7-20	V	100	591.075	16.125	2.250	5.911
7-21	W	106	567.075	12.000	2.250	5.350
7-22	X	57	442.388	21.000	2.250	7.761
7-23	Y	67	523.125	12.375	2.438	7.808
7-24	Z	107	558.763	12.375	2.625	6.124
7-25	AA	81	626.138	17.625	2.250	7.730
7-26	BB	82	546.113	13.313	2.250	6.660
7-27	CC	94	433.238	11.625	2.325	4.609
7-28	DD	100	620.138	12.750	2.250	6.201
7-29	EE	96	734.213	12.750	2.625	7.679
7-30	FF	81	575.288	13.125	2.250	7.102
7-31	GG	70	613.538	12.375	3.375	8.760
Totals		1,219	8,456.813	21.000	1.688	6.938

Table of the Weights of the Albacore Taken at Each Fishing Station (c)

Third Cruise

Date	Station	Number of Fish Taken	Weights in Kg			
			Total Weight	Maximum	Minimum	Average
9-13	HH	93	859.200	13.125	2.625	9.233
9-14	II	82	794.325	13.313	2.700	9.686
9-18	JJ	87	777.638	18.375	2.050	8.940
9-19	KK	67	602.813	13.500	2.250	8.996
9-21	LL	101	920.888	16.575	2.063	9.116
9-22	MM	282	2,676.848	16.875	2.250	9.491
9-23	NN	104	977.063	12.000	3.000	9.394
9-24	OO	165	1,558.080	17.125	4.500	9.443
9-25	PP	229	2,194.125	21.000	4.875	9.626
9-26	QQ	126	1,142.250	15.000	2.438	9.056
9-27	RR	86	786.938	13.125	3.000	9.150
9-28	SS	149	1,357.688	11.625	3.375	9.113
9-29	TT	103	959.625	11.625	3.750	9.315
9-30	UU	40	367.313	11.250	7.125	9.184
10-1	VV	55	490.185	11.250	7.125	8.910
10-2	1	60	514.125	10.500	3.000	8.569
10-4	2	125	1,133.063	12.375	5.063	9.064
10-5	3	54	496.913	13.500	2.625	9.203
Totals		2,008	18,609.765	21.000	2.050	9.266

Table of the Ecological Study of Albacore (8)-1 First Cruise

	Station	Weight	Length	Girth	Sex	Stomach Contents
		kg	mm	mm		
5-28	B	11.991	810	570	M	1 small squid, many Euphausia sp.
		12.991	790	570	F	many Euphausia sp.
		12.375	800	590	F	1 small fish (unidentified)
		10.500	740	540	F	many Euphausia sp.
		9.000	700	540	M	many Euphausia sp.
5-29	C	11.250	765	565	F	1 small squid, many Euphausia sp.
		11.250	765	565	M	1 small squid [sujiika], many Euphausia sp.
		11.400	755	580	F	many Euphausia sp.
		13.500	820	630	F	1 small squid, few Euphausia sp., few Isopoda sp.
		13.125	750	600	F	1 small squid, few Euphausia sp., many Isopoda sp.
5-30	D	7.500	780	505	F	many small squid, many Isopoda sp.
		11.991	760	570	M	many small squid, many Isopoda sp.
		10.125	670	500	M	1 bait sardine, many Isopoda sp.
		11.250	770	550	M	1 Euphausia sp.
		7.500	660	470	M	many small squid, many Isopoda sp.
5-31	E	16.875	790	580	F	nothing
		11.250	820	590	F	a little almost digested unidentifiable matter
		12.750	730	540	M	a few Anisopoda sp.
		17.625	850	600	F	nothing
		14.625	840	620	M	nothing

Table of the Ecological Study of Albacore (8)-1 First Cruise (cont.)

Date	Station	Weight	Length	Girth	Sex	Stomach Contents
		kg	mm	mm		
6-1	F	9.375	710	540	M	a few Anisopoda sp.
		10.500	820	610	F	a few Anisopoda sp.
		10.875	725	545	M	a few Anisopoda and Isopoda sp.
		9.750	700	535	M	a few Anisopoda sp. and Isopoda sp.
		9.375	700	515	F	Anisopoda sp., Isopoda sp.
6-3	H	12.750	825	580	M	a little fish flesh
		10.500	760	550	M	almost digested unidentifiable matter
		9.000	690	560	M	1 crab
		17.625	870	650	M	nothing
		14.250	805	620	F	Anisopoda sp.
6-4	I	10.500	720	550	M	nothing
		12.750	745	520	M	a few small squid
		11.991	680	510	F	Isopoda sp, Anisopoda sp., a little digested matter
		13.575	745	540	M	1 bait sardine, a few small squid
		11.625	770	555	M	1 small squid, Euphausia sp.
		14.250	840	615	F	1 sardine, 1 small squid, Anisopoda sp.
6-5	J	14.250	760	460	M	a few small squid, a few Carinaria sp., a few Anisopoda sp.

Table of the Ecological Study of Albacore (8)-1 First Cruise (cont'd)

Date	Station	Weight	Length	Girth	Sex	Stomach Contents
		kg	mm	mm		
		9.000	690	520	M	a few small squid, a few Carinaria sp., a few Anisopoda sp.
		13.875	835	610	F	nothing
		9.375	695	520	M	a few Anisopoda sp.
6-5	J	8.625	690	510	M	a few Isopoda sp.
6-6	K	13.125	720	550	M	1 bait sardine
		9.000	700	530	F	a few Isopoda sp.
		8.625	695	515	M	a few Isopoda sp.
		10.125	765	650	M	a few small squid, a few Euphausia sp.
		10.875	740	550	F	a few Isopoda sp., a few Carinaria sp.
		14.250	830	640	M	1 small fish (unidentified), 1 bait squid, 1 medium-sized squid, a few small squids, many Isopoda sp.
6-12	Q	15.000	830	630	F	nothing
		13.875	800	600	M	1 small squid
		16.125	830	650	F	1 small squid, a few Isopoda sp.
		14.250	810	620	F	a few Anisopoda sp., a few Isopoda sp.
		14.625	840	640	F	bait sardines, a few Anisopoda sp.

Table of the Ecological Study of Albacore (8)-1 Second Cruise

Date	Station	Weight	Length	Girth	Sex	Stomach Contents
		kg	mm	mm		
7-16	R	10.500	750	580	M	2 small squid
		11.625	775	590	M	1 small squid, 2 small octopi
		9.375	715	545	M	nothing
		12.375	780	610	M	2 small squid
		13.125	800	630	F	nothing
7-17	S	9.375	720	540	F	nothing
		9.000	700	520	M	nothing
		11.625	770	570	F	1 small squid
		10.500	755	560	M	5 small squid, 21 small fish (unidentified)
		11.250	750	570	M	nothing
7-18	T	9.750	725	540	M	1 small fish (unidentified)
		12.375	785	570	M	3 Euphausia sp., 3 small fish (unidentified)
		8.250	670	520	F	1 small fish (unidentified)
		4.125	580	400	M	nothing
		12.000	770	580	F	nothing
7-19	U	3.188	510	400	F	nothing
		9.750	720	550	F	1 small fish (unidentified)

Date	Station	Weight	Length	Girth	Sex	Stomach Contents
		kg	mm	mm		
7-19	U	8.250	680	520	F	9 small squid, 1 small Plagiodus ferox, 1 Euphausia sp.
		9.375	700	540	M	4 small squid
		9.750	710	550	M	1 Euphausia sp.
7-20	V	2.250	485	335	M	nothing
		2.738	530	390	F	1 small squid, 1 Anisopoda sp.
		2.325	510	360	F	1 Anisopoda sp.
		2.325	485	365	F	1 Euphausia sp., 1 Anisopoda sp.
		8.250	685	530	F	1 Anisopoda sp.
7-21	W	2.625	470	355	F	1 Anisopoda sp.
		9.375	710	570	F	4 small squid, 1 Euphausia sp.
		2.550	490	350	F	1 Anisopoda sp.
		2.625	480	360	F	1 Anisopoda sp.
		2.625	490	310	F	12 Euphausia sp., 1 small squid
7-22	X	9.750	760	540	F	12 small squid
		8.625	690	530	F	1 small squid, 1 Anisopoda sp.
		4.688	580	420	F	1 small squid

Table of the Ecological Study of Albacore (S)-1 Second Cruise (con't.)

Date	Station	Weight	Length	Girth	Sex	Stomach Contents
		kg	mm	mm		
7-22	X	8.625	700	550	F	1 small squid
		2.250	480	340	F	nothing
7-23	Y	8.625	690	530	F	1 small squid, 1 Anisopoda sp.
		11.625	780	620	F	16 small squid, 1 small P. ferox
		2.625	525	350	F	12 small squid, 1 small fish (unidentified)
		11.250	750	570	M	nothing
		8.250	680	510	M	1 small fish (unidentified)
7-24	Z	9.750	760	580	F	1 small fish (unidentified), 1 Anisopoda sp., 2 small squid, 1 small jellyfish, 1 Euphausia sp.
		2.625	580	360	F	nothing
		9.750	730	560	F	1 Euphausia sp., 1 small squid
		10.500	740	550	F	a few small fish (unidentified), 1 small squid, 2 Euphausia sp.
		8.400	700	540	F	1 small jellyfish, 1 Euphausia sp., 1 Anisopoda sp.
7-25	AA	8.625	720	540	F	12 small fish (unidentified), 2 small squid
		7.500	670	510	F	6 small fish (unidentified), 1 small squid

Table of the Ecological Study of Albacore (8)-1 Second Cruise (Con't.)

Date	Station	Weight	Length	Girth	Sex	Stomach Contents
		kg	mm	mm		
7-25	AA	7.500	680	500	F	1 small fish (unidentified), 6 Euphausia sp.
		10.500	750	580	F	26 small fish (unidentified), 4 small squid
		3.188	530	385	F	3 small fish (unidentified)
7-26	BB	2.813	510	360	F	1 small squid
		4.125	550	420	F	2 small squid, 1 Anisopoda sp.
		3.000	525	380	M	8 small squid, 2 small fish (unidentified), 3 small P. ferox
		9.375	740	560	F	1 small squid, a few small fish (unidentified), 1 Anisopoda sp.
		9.750	770	590	F	a few small fish (unidentified)
7-27	CC	2.400	470	350	F	nothing
		2.775	480	365	F	2 small squid, 1 Anisopoda sp., 4 Euphausia sp.
		2.625	480	350	F	a few small fish (unidentified), 1 small jellyfish, 4 Euphausia sp.
		3.188	520	385	F	8 small squid, 1 small P. ferox, 1 Euphausia sp.
		3.000	500	370	M	2 small squid, 3 small fish (unidentified)
7-28	DD	5.428	475	475	F	2 small squid, a few Anisopoda sp., 32 Euphausia sp.

Table of the Ecological Study of Albacore (8)-1 Second Cruise (Con't.)

Date	Station	Weight	Length	Girth	Sex	Stomach Contents
		kg	mm	mm		
7-28	DD	5.063	600	460	F	nothing
		9.000	710	530	F	a few small fish (unidentified)
		2.625	500	395	F	a few small fish (unidentified), 21 Euphausia sp.
		9.188	690	550	F	bellyfull of small fish (unidentified)
7-29	EE	11.625	760	600	F	3 small squid
		9.000	745	530	F	52 Euphausia sp.
		3.375	520	410	F	2 small fish (unidentified), 3 Euphausia sp.
		9.375	740	540	M	a few small fish (unidentified), 3 Euphausia sp.
		11.925	780	560	F	1 small squid, 74 Euphausia sp.
7-30	FF	4.875	575	430	M	1 small jellyfish, 2 Euphausia sp.
		2.813	500	350	F	2 small squid, 33 Euphausia sp.
		3.938	550	415	F	3 small squid, 8 Euphausia sp.
		9.375	700	560	F	51 Euphausia sp.
		4.125	560	430	F	4 small squid, 1 small fish (unidentified)
7-31	GG	8.250	695	540	F	nothing
		9.375	730	530	F	nothing
		8.625	695	550	F	28 Euphausia sp.
		10.125	790	590	F	6 small squid, 3 Euphausia sp.
		9.750	725	565	F	nothing

Table of the Ecological Study of Albacore (8)-1 Third Cruise

Date	Station	Weight	Length	Girth	Sex	Stomach Contents
		kg	mm	mm		
9-13	QQ	3.750	530	415	F	3 small octopi
		2.625	470	365	F	Euphausia sp.
9-14	II	11.625	760	590	F	a few small squid
		10.875	790	580	F	a few small squid
		11.063	780	580	M	a few small squid
		11.625	780	590	F	a few small squid
		12.000	810	610	M	a few small squid
9-18	JJ	9.375	740	540	F	Euphausia sp.
		12.000	810	590	F	Euphausia sp.
		3.000	540	390	M	Euphausia sp.
		4.500	570	420	M	a few small squid, Euphausia sp.
		8.250	710	520	M	a few small squid, Euphausia sp.
9-21	LL	11.625	810	580	M	nothing
		12.000	810	610	M	nothing
		13.125	810	620	F	Euphausia sp.
		9.938	720	540	M	Euphausia sp.

Date	Station	Weight	Length	Girth	Sex	Stomach Contents
		kg	mm	mm		
9-21	LL	8.625	760	520	F	Euphausia sp.
9-22	MM	9.750	765	560	F	Euphausia sp.
		10.125	750	560	F	Euphausia sp.
		10.688	750	580	F	Euphausia sp.
		13.125	850	630	M	3 small squid, 1 small octopus, Euphausia sp.
		11.813	820	595	F	Euphausia sp.
9-28	SS	11.250	820	580	M	Euphausia sp.
		8.625	750	530	F	Euphausia sp.
		8.625	750	530	F	Euphausia sp.
		3.375	535	385	F	Euphausia sp.
		9.000	760	540	M	Euphausia sp.
10-1	VV	88.813	735	545	F	nothing
		9.750	760	550	M	nothing
		8.625	740	540	M	nothing
		7.875	700	525	F	nothing
		10.125	778	570	F	nothing
10-4	2	9.375	760	555	F	Euphausia sp.
		9.000	735	535	F	Euphausia sp.
		10.125	780	575	M	Euphausia sp.
		7.875	715	500	M	Euphausia sp.
		9.000	770	530	F	Euphausia sp.

Report of Results of Development of Albacore Fishing Grounds

Miyagi Prefecture Fisheries Experiment Station, Kesennuma Branch

1. Name of vessel - Miyagi Maru
2. Type of operation - Exploration of albacore grounds
3. Outline of operations

These experiments were carried out in continuation of the previous year's operations. The Miyagi Maru of this Branch Station was assigned to Survey Area I, and it was decided to begin operating in May. The Miyagi Maru was due for its regular inspection this year, and on March 24 work was begun on repairs to the hull and engine at the Asano docks in Yokohama. These preparations were affected by the Incident and took an unexpectedly long time so that the vessel did not return to Kesennuma with repairs completed until June 4. After this preparations for sailing were hastened and the vessel left on its first cruise June 10 from Kesennuma. On this cruise the vessel fished seven times in the offshore waters and then the radio operator had a cerebral hemhorrage and was completely paralyzed so that unfortunately it was necessary to halt the operations halfway through. The return voyage was begun July 10 and the vessel reached Kesennuma on the 31st.

Departure for the second cruise was delayed by the conference of seven prefectures and one Korean province on oceanographic investigations, and by preparations for the simultaneous oceanographic observations to be carried out in August. The vessel sailed from Kesennuma August 7 and returned 44 days later on September 19.

On the third cruise the vessel sailed from Kesennuma September 25 with its return to that port scheduled for October 31. This marked the completion of operations.

During these experiments supervision was entrusted to Regional Agriculture and Forestry Technician Hideichi Yoshida (first and third cruises) and Agriculture and Forestry Assistant Technician Noriji Takizawa (second cruise).

4. Conditions on the fishing grounds

Throughout all three cruises the currents on the fishing grounds were generally gentle and were in approximate agreement with the Pacific Ocean Current Charts for the period. On the first cruise the currents were SE - SSE with velocities of about 0.5 - 0.7 knot. On the second and third cruises they were particularly gentle and seemed to be somewhat more easterly.

The surface water temperature showed a maximum of 19° and a minimum of 14.7°. On the first and second cruises the difference between the temperatures of the surface and middle layers ranged from one degree to 10° at different places, but some fish were taken on all fishing grounds. On the third cruise as the vessel moved northward surface

temperatures of 15-16° were encountered and although there were places where the difference between the surface temperature and that of the middle layers reached a maximum of 5° for the most part there was almost no difference. There were also some places where the temperature in the middle layers was 0.2° - 0.6° higher than that of the surface, but good fishing was found on all grounds. On all three cruises the albacore were few and large where water temperatures were high, and where the water was cold the fish were small but densely schooling.

5. Relation of weather and currents to bait-taking

On the first and second cruises the fish did not bite as well as expected, but some catch was had on all fishing grounds. The catches were extremely sparse and it was wondered whether it might not be because of a seasonal dispersion or because they had moved north into the high latitudes through the surface waters. On the third cruise quite a bit of fish was caught in the designated high latitudes, but in the long run the most important factor in the way the fish bite is the density of the schools. Where the schools are dense the fish bite well, and where the schools are sparse they bite badly.

As for the influence of weather, the fish bite well when it is cloudy or when it looks like rain or after a change in the weather. They do not necessarily bite well in the midst of a storm. The relation between currents and the way the fish bite is not clear, but in general they bite well where the current flows and the fishing grounds are highly mobile.

6. Methods of preserving bait and the relation of freshness of bait to the way the fish bite

Baits used were frozen squid, frozen mackerel, and salted sardines. The frozen bait was kept by refrigeration in the cold storage. On the first cruise the salted sardines were purchased at Misaki, but for the second and third cruises sardines taken in set nets at Kesennuma were salted down and preserved in boxes.

The fish bit better, of course, on the fresher bait. As for the salted sardines, the fat ones showed "burning", lost their gloss, and were disappointingly poor bait. With lean sardines there was no burning, the gloss was good, and it appeared after all that lean sardines make better bait. When using them as live bait, the fish bite better on the fat ones. [A table of data on bait is omitted here in the translation.]

7. Largest and smallest albacore taken

The biggest catch was the 196 fish taken on the third cruise (October 15). Fifteen of these fish averaged 70.1 cm long and 8.25 kg in weight.

Item	Weight	Length	Date Taken
Largest	18.38 kg	90 cm	8-28
Smallest	1.50	41	9-5

8. Methods of handling and preserving the freshness of the catch

The fish which were captured were immediately wrapped in waxed paper and then further in newspapers or cloth. They were stowed in two layers in the ship's cold storage space, and the spaces between them were filled with crushed ice. The fish was not completely frozen but the refrigerator was run enough to keep the ice from melting and to keep the temperature in the cold storage space always at 3-5° below zero. Results were better where the fish were wrapped in cloth than when they were wrapped in newspaper. There were some fish, however, which turned gray and lost their value.

9. Where and how sold

The fish from all three trips were landed and sold at auction at the Kesennuma market.

10. Summary table of the results of operations [Omitted as the essentials were summarized in Tables 4 and 5 earlier. Likewise the following tables of the number and value of the fish taken on each cruise.]

11. Opinions regarding the vessel, gear, fishing methods, fishing grounds, and fishing season

(a) It would be desirable to have a large vessel of the 200-300 ton class, designed purely for longline fishing, with large fishholds like those of a transport vessel, equipped with refrigeration and, of course, insulation, and able to remain at sea for at least one month or more.

(b) For the trunk lines 8-momme cotton line like that used by this vessel appeared satisfactory. Good results were had by using similar 7 or 8-momme cotton for the branch lines with fine wire for the leaders. Swivels were put in all of the branch lines.

(c) As for fishing method, setting of the lines was completed early in the morning and after one patrol along the lines hauling in was begun. In longline fishing the schools are not seen and the lines are set with reference to the water temperature and color and the abundance or scarcity of plankton, therefore it is necessary to use a great amount of gear. The line hauler has to be run a great deal and should be constructed so that when there are no fish on the line it can be hauled at high speed and so that the lines will not be abraded.

(d) The fishing grounds change with the season, but during the same season the fishing is good in Areas I and II in the highest latitudes which the warm current reaches and where the water temperature is 15-16.5°. The albacore is, after all, a fish which swims at the surface and therefore it is thought that in the summer season the branch lines might be shortened.

(e) Fishing seasons are from May to July and from September to December. It appears that in August there is a seasonal scarcity of fish.

(f) Miscellaneous

The operation of a summer albacore fishery in the offshore waters of the North Pacific is beset by the following two difficulties:

(1) The fishing grounds are far distant and on each cruise there is a great deal of expense for fuel and other items on the trips out and back.

(2) The productivity of these fishing grounds is not proportioned to this expense.

Therefore the fishery can only be established on a commercial basis after all of the factors involved in these two main problems have been studied and improved methods designed to cope with them.

1. To overcome the uneconomical conditions resulting from the distance to the fishing grounds,
   a. Mothership operations
   b. Fleet operations
   c. Single vessel operations

a. Mothership operations

Two large motherships would be used which could carry four or five albacore longlining boats (of about 20 tons) and which would be so equipped that they could remain on the fishing grounds for five or six months. They might also be equipped for canning the fish.

b. Fleet operations

Vessels of the 50-60-ton class would be used exclusively as longline fishing boats, and the fishholds, iceholds, and all other facilities for transporting fish such as are seen on the vessels now in use would be removed. The fleet would be centered around two refrigerator freight vessels of the 500-ton class, and a large auxiliary sailing vessel would be employed as the mothership for the organization.

c. Single vessel operations

Purely longline fishing vessels of the 200-300-ton class with capacious hulls so that they would have fishholds like those of a freighter would be used. They would have complete refrigeration equipment so that they could operate for 40-50 days at a time. Two sets of refrigeration machinery would be required.

Note: In fishing organizations of these types the fishing boats would need to have overall changes made in their deck installations. It is also thought that the longline boats in use at present also require numerous changes in the deck structures, for example, the construction of a lookout platform at the linehauling roller and improvements in the stowage of the line baskets, floats, and flag poles.

2. To raise the productivity of the offshore fishing grounds,

a. Fishing gear

It appears that the catch is generally proportioned to the number of baskets of gear fished. In my view at the very worst a catch of a value of ¥100 can be expected from 100 baskets of line. Accordingly in the future I would like to see the efficiency of large fishing vessels raised to the point where they could fish 500 baskets in 24 hours. This means that the gear and other equipment must be strengthened and new methods of handling it must be devised. In order to strengthen the gear for use in single vessel operations in the future stainless metal wire should be incorporated in the lines. The losses of line each season by fishing vessels at present are very great and are estimated to amount to 500-1,000 yen per boat.

The construction of the longlines in general use today is so extremely primitive and results in such inefficiency, inconvenience, and danger in setting and hauling the lines that it will hardly bear examination.

The prevention of tangling of the trunk lines and branch lines or float lines, the simplification of the separation and joining of the lines, and the mechanization of line handling should all be studied. It would be desirable to have numbers stamped on the hooks to facilitate investigations, and the branch lines could well be made very short.

b. Auxiliary fishing gear

Line-hauler rollers, line baskets, line-coilers, line-throwers, and flags have become expensive. There is a need for improvements in wooden floats and the easily broken glass floats.

c. Fishing methods

In order to effect the greatest possible increase in the number of baskets of gear the gear must be improved and time-saving methods must be devised.

1. Specialization
2. Increased efficiency
3. Division of labor
4. Combined use of long branches

That is to say, under 1, two boats should operate as a team, one specializing in laying the line and the other in hauling it. Topic 2 means that in order to raise the effective fishing time of the lines they must be in the water at all times and that it is not proper, as at present, to set and haul the lines in such a way that there is a period when they are not in the water. For day and night fishing the personnel must be divided into watches. With regard to 3, on the present fishing boats each person does not have well-defined duties. There should be a division of tasks so

that each fisherman will become experienced in his special job. As for 4, study should be made of the use of large branches mixed in with the albacore lines so as to catch large fish such as big-eyed tuna and marlins.

d. Fishing grounds

The fishing grounds vary with the season, but in Areas I and II investigations should be made as far north as the warm currents go to areas with water temperatures of about 10°. In the investigations made up to now fishing has been good at temperatures of between 13° and 16.5°. Furthermore, since the North Pacific is very calm in the summer season, means should be devised to advance efficiency to utilize this period fully, and policies should be developed fully to cope with the notoriously stormy weather of late autumn and winter. Also thorough studies should be made with a view to extending the fishing grounds north to the vicinity of the Aleutians, northeast toward the continent, and to the waters off Japan.

e. Fishing seasons

Out of the whole year it is only in August that the fishing grounds and the movements of the albacore are unknown.

Table of Measurements of Albacore.

(Body length is with caudal removed)

First Cruise

Date Taken	Position Where Taken	Number of Fish	Body Length cm	Body Weight kg
6-23	35° 18' N 173° 31' W	11	99	22.50
			87	16.88
			81	12.75
			84	13.88
			85	14.62
			84	14.62
			86	15.37
			85	14.62
			84	13.88
			86	15.37
			85	13.88
6-24	35° 29' N 172° 40' W	3	84	15.37
			85	15.75
			87	16.87
6-25	36° 14' N 174° 0' W	4	76	9.75
			85	13.12
			86	15.37
			69	7.88
6-26	36° 26' N 172° 50' W	11	84	12.38
			76	11.25
			71	9.00
			80	13.13
			78	11.63
			73	10.13
			77	11.63
			72	10.13
			80	13.50
6-27	37° 17' N 171° 48' W	11	79	12.38
			84	13.88
			75	10.50
			81	12.75
			80	13.13
			78	10.87
			81	13.13
			74	10.13
			80	13.50

First Cruise - /Continued/

Date Taken	Position Where Taken	Number of Fish	Body Length cm	Body Weight kg
6-28	38° 12' N 170° 01' W	14	49	2.85
			49	2.70
			49	2.70
			45	2.25
			69	7.85
			69	8.25
			82	12.75
			72	8.25
			71	9.38
			73	9.76
			79	11.25
			49	2.63
			79	10.13
			73	9.00
	Second Cruise			
8-27	43° 21' N 174° 05' W	12	72	9.00
			75	9.38
			78	10.88
			73	10.13
			78	12.36
			72	10.13
			82	14.63
			71	8.25
			91	17.25
			90	15.75
			75	8.25
			76	11.25
8-28	43° 32' N 173° 38' W	10	49	3.00
			50	3.38
			78	11.63
			77	11.25
			90	18.38
			82	12.00
			73	9.38
			81	12.00
			79	12.75
			45	2.81
8-29	43° 10' N 171° 58' W	3	74	9.65
			85	14.63
			85	15.00

econd Cruise - [Continued]

ate Taken	Position Where Taken	Number of Fish	Body Length cm	Body Weight kg
8-30	43° 39' N 170° 35' W	12	78	11.63
			75	9.38
			79	11.63
			79	11.63
			73	8.25
			73	9.00
			50	3.00
			47	2.40
			47	2.51
			50	3.11
			50	2.81
8-31	43° 41' N 169° 20' W	21	86	14.25
			86	15.00
			71	7.88
			78	12.00
			73	9.00
			73	9.38
			73	9.38
			75	9.00
			84	15.00
			75	10.13
			79	11.63
			75	9.65
			75	9.65
			70	7.88
			73	9.38
			71	8.63
			72	9.38
			48	2.43
			50	2.81
			48	2.43
			51	3.00
9-1	43° 10' N 168° 04' W	3	81	12.00
			79	11.25
			81	12.00
9-2	42° 38' N 166° 44' W	6	81	12.38
			76	11.25
			81	12.00
			75	10.88
			80	13.13

Second Cruise - /Continued/

Date Taken	Position Where Taken	Number of Fish	Body Length cm	Body Weight kg
9-3	42° 54' N 165° 26' W	12	75	9.65
			79	11.25
			74	9.38
			78	11.25
			73	9.38
			73	9.65
			73	9.38
			71	9.38
			75	10.31
			79	12.00
			70	12.00
			72	9.00
9-4	42° 12' N 166° 48' W	9	44	2.06
			76	11.25
			75	9.65
			75	11.63
			77	12.38
			77	12.63
			76	10.13
9-5	41° 52' N 168° 34' W	13	41	16.13
			91	17.25
			82	13.13
			77	10.50
			77	10.88
			79	11.63
			77	12.00
			75	10.88
			83	14.25
			81	13.13
			41	1.50
			85	14.63
			80	12.75
9-13	43° 50' N 164° 02' E	27	49	3.00
			48	2.63
			47	2.25
			51	3.08
			49	2.96
			45	2.03
			51	3.26
			51	3.38
			51	3.30
			49	3.00

Second Cruise - /Continued/

Date Taken	Position Where Taken	Number of Fish	Body Length cm	Body Weight kg
9-13	43° 50' N 164° 02' E	27	51	3.38
			51	3.53
			44	2.18
			44	2.25
			44	1.99
			48	2.63
			51	3.56
			49	2.63
			49	3.00
			72	9.38
			79	12.00
			78	11.25
			82	13.88
			78	12.00
			52	3.45
			52	3.38
	Third Cruise			
10-6	43° 24' N 175° 00' W	174	74	9.38
			68	7.88
			69	8.63
			68	7.50
			70	8.63
			72	9.00
			68	6.75
			72	7.88
			73	9.38
			72	8.25
			72	8.63
			76	10.13
			74	9.65
			90	17.25
			87	13.88
			71	10.13
			71	8.25
			72	8.63
			73	8.63
			70	7.50
			72	8.63
			75	10.13
			72	9.00
			74	9.38
			71	8.25

Third Cruise - /Continued/

Date Taken	Position Where Taken	Number of Fish	Body Length cm	Body Weight kg
10-6	43° 24' N 175° 00' W	174	69	7.50
			69	7.50
			70	7.88
			70	7.88
			67	7.13
			79	11.62
			55	3.75
			56	3.75
			57	4.13
10-7	43° 32' N 174° 23' W	123	70	8.25
			71	9.00
			73	9.00
			67	7.88
			70	8.63
			70	9.00
			67	8.25
			70	7.88
			70	7.88
			72	8.63
			69	7.13
			78	11.25
			70	8.25
			71	7.88
			75	9.38
			71	8.25
			73	9.00
			75	9.38
			70	8.25
			74	9.00
			75	9.38
			75	9.65
			75	9.38
			74	9.00
			70	7.88
			70	8.25
			72	8.63
			72	8.25
			73	9.00
			60	5.25
			51	3.00

hird Cruise - /Continued/

Date Taken	Position Where Taken	Number of Fish	Body Length cm	Body Weight kg
10-8	43° 31' N 174° 48' W	112	70	9.38
			69	7.88
			70	7.88
			70	8.63
			71	8.63
			70	7.50
			69	7.88
			70	8.25
			71	9.00
			68	7.88
			58	4.50
			58	4.50
			58	4.88
			54	3.38
			56	4.50
			71	8.25
			72	8.25
			73	8.63
			71	7.88
			66	7.13
			68	7.50
			71	8.25
			71	7.88
			72	8.63
			69	7.88
			88	16.12
			85	14.63
			89	15.75
			85	14.25
			75	10.13
10-9	43° 12' N 174° 35' W	116	71	8.25
			73	9.38
			70	8.25
			72	8.63
			70	7.88
			73	8.25
			67	6.38
			70	7.88
			72	8.25
			67	6.75
			71	7.88
			71	9.38
			69	7.88
			70	8.25
			68	7.88

Third Cruise - /Continued/

Date Taken	Position Where Taken	Number of Fish	Body Length cm	Body Weight kg
10-9	43° 12' N 174° 35' W	116	76	12.25
			76	10.88
			70	7.88
			72	8.63
			75	9.65
			71	7.50
			69	7.88
			67	6.75
			76	9.65
			72	9.00
			63	5.63
			63	5.25
			56	4.13
			52	3.00
			53	3.38
10-11	43° 01' N 174° 07' W	43	74	9.65
			61	5.63
			74	10.13
			71	7.50
			70	7.88
			75	10.13
			71	8.25
			71	8.25
			72	8.25
			73	9.00
			68	7.13
			70	7.88
			72	8.25
			69	7.50
			72	8.25
			75	9.00
			76	9.65
			75	9.65
			73	9.38
			53	3.75
			49	3.00
			49	2.65
			50	2.65
			73	9.38
			71	8.25
			74	9.38
			69	7.50
			72	8.63
			71	8.63

Third Cruise - /Continued/

Date Taken	Position Where Taken	Number of Fish	Body Length cm	Body Weight kg
10-11	43° 01' N 174° 07' W	43	68	7.50
			71	8.25
			74	9.38
			74	9.38
10-12	43° 05' N 174° 28' W	135	70	7.88
			73	9.38
			72	8.63
			69	7.50
			71	8.63
			70	7.50
			72	8.25
			69	7.50
			75	10.13
			71	8.63
			73	9.38
			72	8.25
			70	7.88
			70	7.50
			73	9.65
			71	7.88
			76	10.50
			71	8.63
			74	10.50
			71	9.00
			77	10.50
			73	9.00
			74	9.38
			69	7.50
			72	9.00
			71	8.25
			76	10.13
			72	9.00
			73	8.63
			73	9.38
10-13	43° 18' N 174° 40' W	86	71	8.25
			70	7.50
			74	9.38
			69	7.50
			72	8.25
			71	8.25
			75	10.50
			73	9.00
			64	6.75
			66	7.13

Third Cruise - /Continued/

Date Taken	Position Where Taken	Number of Fish	Body Length cm	Body Weight kg
10-13	43° 18' N 174° 40' W	86	76	10.13
			74	9.65
			65	6.75
			69	7.88
			72	8.25
			68	7.50
			70	8.25
			74	9.65
			71	8.63
			70	8.63
			69	7.88
			77	11.25
			74	9.38
			74	9.38
			73	9.00
			61	5.25
			70	7.88
			67	7.50
			70	7.88
			71	8.25
			94	19.13
			50	2.63
10-15	41° 44' N 173° 28' W	196	67	6.75
			71	8.65
			72	9.00
			67	6.75
			70	7.50
			70	8.63
			74	10.13
			72	9.38
			72	9.38
			73	8.63
			68	8.25
			69	8.25
			67	6.75
			72	8.25
			75	10.13
			65	6.75
			70	7.88
			69	8.63
			69	7.88
			72	8.63
			67	7.88
			70	8.63
			69	8.63

Third Cruise - [Continued]

Date Taken	Position Where Taken	Number of Fish	Body Length cm	Body Weight kg
10-15	41° 44' N 173° 28' W	196	71	7.88
			64	6.00
			74	9.00
			74	9.38
			72	8.63
			69	7.88
			70	8.25
			88	15.75
			51	2.96
10-16	42° 30' N 173° 28' W	58	68	7.50
			68	7.50
			69	7.88
			67	7.50
			72	8.63
			65	6.75
			68	7.50
			69	8.63
			67	7.50
			69	8.25
			58	4.50
			70	8.25
			69	7.88
			70	8.25
			72	9.00
			70	7.88
			70	7.88
			68	7.50
			69	8.25
			67	7.50
			73	9.38
			72	9.38
			73	9.00
			72	9.00
			67	6.75
			71	8.25
			71	8.25
			69	8.63
			75	10.13
			74	9.65
			89	16.50
			49	2.85
10-17	42° 08' N 173° 14' W	109	66	6.75
			71	9.00
			66	6.75
			70	7.88
			69	7.50

Third Cruise - [Continued]

Date Taken	Position Where Taken	Number of Fish	Body Length cm	Body Weight kg
10-17	42° 08' N 173° 14' W	109	69	7.88
			70	8.63
			78	10.13
			68	6.75
			70	7.88
			71	8.63
			69	7.50
			70	7.88
			67	7.13
			69	7.50
			68	7.88
			69	7.50
			68	7.88
			69	7.88
			73	9.38
			74	9.38
			71	7.88
			71	9.00
			57	4.88
			70	7.88
			78	11.25
			70	8.25
			71	8.63
			69	7.13
			72	8.25
			48	2.74

Report of Results of Development of Albacore Fishing Grounds

Aomori Prefecture Fisheries Experiment Station

1. Vessel - Aomori Maru
2. Type of operation - albacore fishing ground exploration
3. Outline of operations

In this year's investigations the Aomori Maru was assigned to the survey of Area I. In order to enable the vessel to undertake such long voyages she was put in the Asano docks at Yokohama on April 20 for repairs to the hull and engine. She came out of the dockyard on June 3 and proceeded to Hachinoe harbor where all preparations for fishing were made. On June 21 the vessel left Hachinoe on its first cruise and on November 12 she returned to Misaki completing her third cruise and marking the end of the year's operations.

First Cruise

The vessel sailed from Hachinoe harbor on June 21 and arrived on the fishing grounds July 3. Twelve fishing trials were made in the area between 171° W and 176° E and 33° - 37° N. The catch was 38 albacore, 83 big-eyed, 23 striped marlin, 165 Galeus glaucus, 5 Lampris regia, 1 black marlin, 1 Scoliodon walbechmi, 6 Isurus glaucus, and 2 broadbill swordfish. The vessel was on the way back to Misaki, but the schedule was changed en route and she put in at Katsuura in Chiba Prefecture where most of the catch was sold. The remainder was sold at Hachinoe. The value of the landings was ¥ 1,907.

Second Cruise

The vessel departed Hachinoe for the fishing grounds on September 3, but returned without fishing because of engine trouble en route. She arrived back at Hachinoe on the 25th of September.

Third Cruise

The vessel departed Hachinoe October 5 and put in at Kamaishi for fuel. On October 7 at 6:00 P.M. she sailed from Kamaishi for the fishing grounds.

From October 20 to October 31 11 fishing operations were carried out in the area between 38° - 41° N and 173° W - 174° E. The catch comprised 1,615 albacore, 16 big-eyed tuna, 2 broadbill, 2 striped marlin, 7 Isurus glaucus, and 96 Galeus glaucus. This catch, the landed value of which was ¥ 6,466, provided a successful ending to the season's operations.

4. Conditions on the fishing grounds

On the first cruise the currents on the fishing grounds were generally northeasterly or easterly with speeds of about one knot. Albacore were taken at places where the water temperature was 19-21°, with a water color of 4 and a transparency of about 18 meters, but no albacore were found at all

where the water temperatures were higher than 21°. On the third cruise the currents were generally north and slightly westerly with speeds of 1 to 1½ knots. The best catches were obtained where the water color was from 3 to 4 with a transparency of about 16 to 17 meters and the surface temperature was from 16.5° to 16.8° with a temperature of about 13.8° at the 100-meter level. It was not possible to collect plankton because of damage to the plankton net, but the presence of great quantities of gobies in the bellies of the fish indicated that natural food was fairly abundant.

Boobies were extremely abundant and during operations a flock of them could always be seen at the stern of the vessel.

5. Relation of weather and currents to bait-taking

During the first cruise the weather was generally good, but perhaps because of the grounds fished the fish did not bite very well. On the third cruise there were many days of bad weather, the currents were complex, and much difficulty was experienced in operating, however, the albacore bit very well. The fish were small (.25 to 1.00 kan / 1 kan = 8.27 pounds/), but the schools were very dense. The fish bit best from the third to the eighth trial in the vicinity of stations X 3 and X 4. On the sixth trial the highest record of eight fish on one basket of line (9 hooks) was made, and most of the baskets caught two or three fish. Just for our information data were compiled for 50 baskets with the following results:

Catch ratios per basket

8 fish per basket	1 basket	8 fish
6 fish per basket	1 basket	6 fish
5 " " "	3 "	15 "
4 " " "	4 "	16 "
3 " " "	16 "	48 "
2 " " "	11 "	22 "
1 " " "	10 "	10 "
Total	50 "	125 "

6. Method of holding bait, relation of freshness to bait-taking, and table of data on bait

On the first cruise frozen mackerel, frozen squid, and salted sardines were used for bait. The frozen bait was placed in the fishhold and the refrigeration machinery was operated sufficiently to keep it from melting. The salted sardines were kept in covered boxes stacked in a suitable space on deck with no untoward effects. On the third cruise only frozen mackerel and salted sardines were used. The mackerel may have been inferior to begin with, but when they were used they were in a low state of freshness, they stayed on the hook poorly, and the fish did not bite well on them. The salted sardines, on the other hand, were of high quality, held the hook well, and were taken well by the fish.

On the third cruise the frozen mackerel and the salted sardines were used together. A comparison of the success obtained with these baits showed that the fish did not bite well on the frozen mackerel. In short, it is

wondered whether when frozen fish are kept in sea water for long periods of time they do not lose their shape and become poor bait.

[A table of data on bait is omitted here.]

7. Sizes of the largest and smallest albacore taken, along with the number taken in the largest single catch and their average size.

Largest	5.500 kan	80 cm	Taken October 22
Smallest	2.000	57	Taken October 26

The biggest single catch was during the third cruise when 246 fish were taken on October 27. Their average weight was 2.500 kan.

8. Methods of handling and preserving the catch

Large fish such as the big-eyed tuna and the marlins were opened up immediately after capture and the gills and viscera were removed. Albacore and other smaller fish were stowed in the round. The fish were first thoroughly washed with sea water and then laid in rows on the racks in the fishhold, covered with muslin, and then covered with enough ice so that the fish could not be seen. The refrigeration machinery was operated sufficiently so that ice would not melt (operating every other day). The sharks were opened and gutted, washed with sea water, stowed in the fishhold with a small quantity of ice, and refrigerated sufficiently to keep them from spoiling.

9. Place and method of sale

On the first cruise the catch was sold partly at Katsuura in Chiba Prefecture and partly at Hachinoe. The catch from the third cruise was sold in the market at Misaki in Kanagawa Prefecture. In all cases sale was at auction by written bids.

Value of Fish Sold

First cruise	¥ 1,907
Third cruise	6,466
Total	8,373

10. Summary table of the results of operations

[This as well as the following table of the value of the catch have been omitted as the essential information is contained in Tables 4 and 5.]

11. Opinions on vessels, gear, methods, fishing grounds, and seasons

a. Fishing vessels

The suitable size for the fishing vessels appears to be from 150 to 200 tons. Because of the distance to the fishing grounds and the time required to get there and back, the vessel should be as fast as possible, should have

a long cruising range, and should be able to carry a large cargo of fish. In other words, the venture will not show a profit unless the vessel can carry over 40 tons of fuel, about 40 tons of ice, and over 10,000 kan of fish.

b. Fishing gear

A comparison of cotton and Manila lines shows that the former is superior both in the catch ratios obtained and in ease of handling. For dyeing the line coal tar dye is best and line so dyed is easiest to handle.

The experience of the third cruise indicates that in fishing for small albacore of about 3 kan weight it would be best to remove the large hooks from the lines and try to place as many small hooks as possible on them. Since the more gear is fished at one time the greater are the catch ratios obtained, it appears that about 200 baskets is a proper amount of line.

c. Fishing methods

Because of the great distance of such fishing grounds as those of Area I it appears that of the three methods of pole fishing, longlining, and trolling, pole fishing is unsuitable because of the bait factor. In the long run it is thought that the best policy is to use longlines as the principal gear and to use trolling lines while under way or while patrolling the lines to locate schools and to increase the total catch. There is a need for a great deal of thought and study to be given to methods of operation of the gear. Attention must be paid to the movements of the schools and to the direction and velocity of the current so that after the lines are hauled in the position of the vessel can be suitably shifted, and when a good fishing ground is reached it is necessary always to have an accurate knowledge of the vessel's position after the lines are hauled so that insofar as possible the vessel will not get off the ground. For this reason when operating at night it is absolutely necessary to ascertain the position by observations of the moon or stars.

d. Fishing grounds and seasons

A consideration of the results of this year's and last year's investigations leads to the belief that around May and June the grounds are in the vicinity of 30-35° N while around August and September they are in the neighborhood of 40-45° N indicating perhaps that the albacore may perform a great migration between the Hawaiian Islands and the Aleutians in which they move south in the winter and north in the summer. It is thought that small albacore of about 2 to 3 kan in weight always swim in schools at the tips of warm currents (about 16-17° temperature) where these form narrow pockets of comparatively uniform temperature.

Report of Results of Development of Albacore Fishing Grounds

Chiba Prefecture Fisheries Experiment Station, Katsuura Branch

1. Vessel - Fusa Maru
2. Type of operation - albacore fishing ground exploration
3. Outline of operations

First Cruise

Preparations for the Fusa Maru to take part in the operations to develop the albacore fishing grounds were begun May 7 and completed May 10. The vessel sailed from Katsuura for the first survey of the fishing grounds, combining this operation with oceanographic observations to be taken 300 miles southeast of Nojimazaki. With the completion of these observations at 8:00 P.M. on May 12 the vessel proceeded directly to the assigned fishing grounds. Fishing was begun on May 21 and 12 fishing operations had been carried out by June 1 when the vessel started the return voyage. On June 12 the vessel arrived at Katsuura and landed its fish. During this period 243 albacore were taken, and the total value of landings was ¥ 1,246.40. This year's first survey area was between 32° and 35°, while the area covered in the first cruise last year was between 28° and 31° N. The surface water temperatures on last year's fishing grounds ranged from a minimum of 20° to a maximum of 23°, while this year's temperatures were from 17.7° to 20.4°.

Second Cruise

After the completion of the first cruise work was done on the fishing gear and general repairs were made. On June 25 the vessel departed Katsuura for the second cruise. Experimental fishing was begun on July 5 and 14 stations were fished before the vessel started on its return voyage on July 19. On July 31 the vessel arrived at Katsuura, where the catch was landed August 1. The species and number of fish caught were as shown in the summary table of operations; 50 albacore were taken and the value of all fish landed was ¥ 1,655.86. The survey area covered in this voyage did not differ greatly from that surveyed in the second cruise last year, however, last year the investigations proceeded from south to north while this year the fishing stations were run in the opposite direction.

Third Cruise

After completion of the regular periodic oceanographic observations the vessel sailed from Katsuura on September 3 for its third cruise. Fishing operations were begun on September 14 and 14 stations were fished by September 28 when the vessel began its return voyage. On October 10 the vessel arrived at Katsuura and landed its catch. The species and numbers of fish taken were as shown in the summary table of operations; 162 albacore were caught and the total value of all the fish landed was ¥ 1,924.46. The area of operations on this cruise was north of 40°N, and many big-eyed tuna and striped marlin were taken in waters where the surface temperatures were around 21°. The albacore taken in these areas were large

ones from 15 to 30 kilograms in weight. As the vessel proceeded northward the surface water temperatures fell to between 14° and 16° and in these areas no striped marlin or big-eyed tuna were caught and the albacore which were taken were small ones of about 6 to 10 kilograms. Small albacore were seen jumping from time to time during operations, but none were taken on the trolling lines.

4. Conditions on the fishing grounds, direction and speed of currents, water temperatures, and water color

First Cruise

The area surveyed was comparatively small in extent, lying between 32-35°N and west of 180°E. The currents were for the most part southerly and very weak, the highest velocity measured being about 0.6 knot. At the beginning of operations a northeasterly current was felt. Surface water temperatures on the fishing grounds were generally variable, but the changes were relatively small. Temperatures were from 17.8° to 19.7° and they dropped progressively by 1° to 3° at each of the prescribed lower levels. The 100-meter level at all fishing grounds showed 14.5° to 16°. While fishing the direction of the lines occasionally changed markedly, and lines of discontinuity were frequently encountered. The water color was generally favorable, but with changes in the temperature while fishing, and of course while cruising there were changes in the color. Plankton was particularly abundant. Transparencies of 20 to 30 meters were measured.

Second Cruise

Compared to the previous cruise the survey area was larger in extent. It was almost the same area as that covered in the second cruise of the previous year except for a northward shift of one degree of latitude. Currents were southwesterly and northeasterly, and they were generally slow with one knot the highest velocity encountered. At several of the 14 fishing stations no current could be detected. Surface water temperatures where albacore were taken were from 15.7° to 21°. As the vessel moved south the temperatures rose to 23° or higher and no albacore were taken at all. Temperatures at the 100-meter level were 11.2° to 14.8° and the difference between temperatures at the prescribed levels was 1° to 2°. Water color was generally favorable, but there were some areas where the transparency was remarkably poor, the range being from 10 to 27 meters. Plankton was abundant all over the survey area.

Third Cruise

The survey area lay north of 40° between 175°E and 178°W, and experimental fishing was carried on over a rather broad range. The currents were extremely complex, there were many lines of discontinuity, and there were some areas where gyrals were formed. Both northwesterly and southeasterly currents were present, and a maximum velocity of 0.9 knot was measured. No current at all could be detected at 2 out of the 14 stations fished. Surface water temperatures were from 14° to around 21°, and changed every 30 or 40 minutes while the ship was under way. It was felt that perhaps the zone of [suitable] water in this area is narrow from east to west and

broad from north to south forming a belt-shape. Temperatures at the 100-meter level ranged from 8.8° to 14°. Water color ranged from 2 to 5 with unfavorable color in the low temperature zones, and transparencies were from 12 to 27 meters. Plankton was abundant just as on the preceding cruise.

5. Relationship between weather and currents and bait-taking by the schools

Throughout the whole operating area the fishing grounds were, just as in the previous year, generally unremarkable. On the third cruise there were comparatively many signs of life on the sea and small albacore were seen jumping, however, there was nothing in the vicinity which could be taken for a school. Albacore schools were not sighted even once during the three cruises, and it appears that they were disrupted by the sea conditions. Generally it seemed that the albacore were somewhat more concentrated than they were the previous year, but the area of distribution was extremely limited and unfortunately it was not possible on any of the three cruises to contact their center of concentration. This is thought, however, to have been due to the oceanographic conditions described above. Otherwise there was nothing in particular to record concerning the relationship of the weather to bait-taking.

6. Methods of preserving bait, relation of freshness to bait-taking, and items in the following table

In the preservation of bait the same methods employed in the previous year were employed and results were generally good. There is nothing in particular to report on this score. In view of the results obtained last year, the emphasis was taken off frozen squid this year and instead salted sardines and frozen mackerel were principally used. In neither case were the fish obtained from commercial dealers. The experiment station obtained directly fresh raw sardines and salted them down immediately. Suitable mackerel were selected and purchased from the stick-held dipnet catches landed at Katsuura. They were immediately gutted, washed, packed full of salt, and then placed in cold storage. The requisite quantity for each cruise was loaded aboard the Fusa Maru. Well-preserved mackerel and sardines are thought to be much more effective than frozen squid as bait for albacore.

[A table of data on bait has been omitted at this point.]

7. Sizes (length and weight) of the largest and smallest albacore taken, and the number and average size of the fish taken in the biggest single haul

Largest	28.87 kg	109.0 cm
Smallest	4.30 kg	60.5 cm

The biggest single catch was taken during the first cruise on May 31 when 59 fish were taken. Their average weight was 15.56 kg and their average length was 89 cm.

8. Method of handling and preserving the catch

The catch was handled and preserved by the same methods followed in the previous year.

9. Place and method of sale

The fish were sold at auction at Katsuura in Chiba Prefecture.

10. Summary table of the results of operations [Omitted. Likewise the table of the value of the catch. Essential information is in Tables 4 and 5 earlier.]

11. Opinions regarding vessels, gear, methods, fishing grounds, and fishing seasons

(a) Fishing vessels

Since the vessel must operate at a great distance for more than a month in the summer season and must fish over a broad area of grounds, it must of course be able to carry a sufficiency of the material necessary in this fishery and the holds must be fully adequate for the stowage of ice, bait, and the catch. From the point of view of increasing the fish stowage capacity it is thought that the vessel should be especially constructed for tuna fishing. Also, in order that fishing may not be interfered with by stormy weather, it is necessary that the bow be so constructed that the fishermen are not directly hit by waves coming from the direction of the bow.

(b) Fishing gear

No particular need is seen for changes in the albacore gear in use hitherto, and longlines are considered suitable. As material for these lines cotton is good, but Manila hemp is all right too.

(c) Fishing methods

Longline fishing method (may be carried on with from 25 or 26 to 30 men divided into two watches)

(d) Fishing grounds and fishing seasons

Further data is required for the investigation of fishing grounds and seasons, and it would probably be best to carry on further surveys by the same methods used this year.

Report of the Results of Albacore Fishing
Ground Development

Akita Prefecture Fisheries Experiment Station

1. Vessel - Akita Maru
2. Type of operation - Albacore fishing ground exploration
3. Outline of operations

The second summer investigations for the development of albacore fishing grounds were carried out in continuation of those of the preceding year and in cooperation with a number of other prefectures.

The Akita Maru, upon completion of the investigations of the winter tuna longline fishing grounds, was docked at the Tōkai Shipyard near Shimizu on April 10 in order to prepare for the operations. Repairs were made to the hull and engine, and fishing gear was constructed and repaired. On May 11 the vessel was undocked and sailed to Misaki where bait, fuel, and ice were taken aboard. With all preparations complete she departed Misaki on May 14 for her first cruise. Thereafter three exploratory cruises were made by September 1. After the completion of the survey work the restoration of the hull, engine, and fishing gear was undertaken, and all operations were finally finished on September 20. An outline of the results of each cruise follows.

First Cruise

On May 14 at 8:50 A.M. the vessel departed Misaki and at 11:30 she turned eastward from her course paralleling Nojimasaki and headed directly for the fishing grounds. Investigations were begun on May 25 in an area with a surface temperature of 20.5° at 31° 32'N, 179° 37'W. No albacore were taken at the first to third fishing stations. The first ones caught were four fish taken on the fourth trial at 34° 26'N, 177° 5'W. From 9 stations fished up to June 4 the catch was 12 albacore, 13 big-eyed tuna, 5 marlin, and 49 sharks. On June 13 the vessel returned to Misaki, concluding the first cruise.

Second Cruise

The vessel departed Tateyama on June 20 at 12:20 P.M. and at 2:37 P.M. the course was changed from one paralleling Nojimasaki to an east by slightly north course for the fishing grounds. Investigations were begun on July 1 in an area with a surface temperature of 20° at 36° 32'N, 176° 18'E. In 10 trials made up to July 10 all parts of the assigned area were investigated, but the catch amounted to only the extremely poor figure of 4 albacore, 14 big-eyed tuna, 20 marlin, and 77 sharks and other fish. Because of the low fuel supply the vessel began its return voyage on July 10, arriving at Misaki July 21 to conclude the second cruise.

Average water temperatures on the fishing grounds during this cruise were 19.5° on the surface, 17.9° at 50 meters, and 15.5° at 100 meters. Temperature changes with depth were very similar to those on the winter

fishing grounds; the vertical changes were slight in comparison with the same season last year. The water color was favorable, but almost no schools were seen and the fishing turned out to be very poor.

Third Cruise

On July 30 at 9:00 A.M. the vessel departed Misaki and headed directly for the fishing grounds. Operations were begun on August 9 at 41° 45'N, 175° 40'E in a surface water temperature of 18.3°. In the 10 days up to August 18 investigations were made all over the area, but results were very poor. The vessel turned southward and on the 21st at 38° 30'N, 177° 30'E a remarkable line of discontinuity was encountered with a water temperature of 18° on the north side and 25° on the south side. Marlin were seen leaping on the south side and the lines were immediately set. In three sets 10 albacore and 116 marlin, big-eyed tuna, and other fish were taken. The total catch for this cruise amounted to 24 albacore, 6 yellowfin, 52 big-eyed tuna, 35 marlin, and 60 sharks. The albacore from the warm-water zones were large fish which averaged 5 - 6 kan apiece.

On September 1 the vessel returned to Misaki and landed its catch. Repairs were made to the hull, engine, and fishing gear, and on September 20 the operations for the year were finished.

4. Conditions on the fishing grounds

Current velocities on the fishing grounds were generally slow and the direction of flow for the most part agreed with that shown on the current charts. Currents were for the most part easterly, and it is thought that the direction and rate of flow were affected by the force and direction of the wind. Surface water temperatures ranged from a maximum of 25.2° to a minimum of 16.8° with an average of 19.1°. At the 100-meter level the maximum was 20.0°, the minimum was 8.9°, and the average was 12.5°. Vertical changes in temperature were slight as compared to the same season of the previous year. On the third cruise areas of whitish turbid water were frequently seen north of 34°N.

5. Relationships between schools and signs of life on the sea, bait-taking and the condition of the schools, and weather and currents and bait-taking

There were many sea-birds (commonly called ōtori) in the assigned survey area, but throughout the investigation the Akita Maru caught only 40 albacore. No albacore schools were seen, but small schools of skipjack and dolphin were frequently sighted. Bait-taking was generally good when there was a slight chop on the surface.

6. Methods of preserving bait and the relationship of freshness to bait-taking

a. Methods of preserving bait

Frozen squid, mackerel, and sardines and salted mackerel and sardines were used for bait. The frozen baits were kept in a cold storage space where the temperature was maintained at 5° - 10° below zero. The salted

baits were just stored in the fishholds, but their freshness was extremely well preserved.

b. Relation of freshness to bait-taking

Schools which bite well will do so even on stale bait.

c. Table of data on bait [Omitted from the translation.]

7. Sizes of the largest and smallest albacore taken, and number, average size, and type of school of the fish taken in the largest single catch

a. Largest and smallest albacore taken

Largest	6.480 kan	4 shaku 1 sun
Smallest	3.500 kan	2 shaku 8 sun

[1 kan = 8.27 pounds 1 shaku = 0.994 foot 1 sun = 1.2 inches]

b. Number of fish in the largest catch

Six fish taken on May 31 at 35° 03'N, 177° 35'E

c. Average size of fish and type of school

Average weight 3.120 kan; average length 2 shaku 7 sun; the school was not seen.

8. Methods of handling and preserving the catch

After capture the fish were carefully washed and individually wrapped in fish-cloth. The gills and viscera were removed from the big-eye and marlin and after a thorough washing the fish were wrapped in cloth and stowed in the refrigerated fishhold. Enough crushed ice was heaped on so that the fish were not visible and the refrigeration machinery was operated sufficiently to keep the inside of the hold at about zero degrees so that the ice would not melt. The sharks were gutted and a small amount of crushed ice was put on them so that they would not spoil.

9. Place and method of sale and value of the catch

Place of sale	Misaki, Kanagawa Prefecture
Method of sale	Auctioned according to the rules of the Misaki fish market
Proceeds from sale	¥ 8,962.73

10. Summary table of the results of operations [Omitted along with a table of the value of the catch. Essential data contained in Tables 4 and 5 earlier.]

11. Opinions on vessels, gear, methods, and seasons

a. Fishing vessels

Since the fishing grounds have, as was reported in 1938, been shifting farther away each year, at least 20 days are required for the trip out and back, and it is essential from an economic point of view to increase as much as possible the number of days spent on the grounds in order to pay the heavy expenses and show a profit. For this reason the vessel, although it may be of either wooden or steel construction, should be very seaworthy and should be a fishing boat especially designed for tuna longline fishing, of at least 140 tons and 250 horsepower. Furthermore, in order to cut down the days of cruising, a hull type should be selected which will be able to put out some speed. If as a result of future investigations the value of the fishing grounds should be increased, the mothership type of operations should be suitable.

b. Fishing gear

Longlines are the most suitable gear. Neither this year nor last year were concentrated schools seen within the survey area, and because the fishing grounds are so far distant it is difficult to transport live bait and pole fishing is therefore impossible. If longlines are employed, it should be possible to take big-eyed tuna, marlin, and sharks in addition to albacore. There is no objection to using the same type of longlines as are in use at present by ordinary fishing vessels. The branch lines should be made about 20 fathoms long and constructed so that they may be suitably shortened if conditions on the fishing grounds require it. For preservation of the lines coal tar dye is best.

c. Fishing methods

The methods in use hitherto are satisfactory.

d. Fishing grounds and seasons

Judging from the results of the investigations made this year and last year, in the southern part of Areas I and II there are only a few of the winter schools remaining and these are large fish; our hypothesis is that at this season the fish move north and occur in a fair degree of concentration in cold water zones north of 43° N.

Report of Results of Albacore Fishing
Ground Development

Iwate Prefecture Fisheries Experiment Station

1. Vessel - Iwate Maru
2. Type of operation - Albacore fishing ground exploration
3. Outline of operations

First Cruise

The vessel departed Misaki in Kanagawa Prefecture on June 5 and on June 15 arrived at 33° 51'N, 175° 14'E in Area II where the lines were set for the first trial. Thereafter 14 stations were fished before the vessel began its return voyage on June 24. At 7:15 A.M. on July 6 the vessel arrived at Misaki and the catch was landed and sold. The catch and the proceeds of its sale are shown in the summary table of operations.

Second Cruise

After the return to Misaki fishing gear was constructed and various preparations were made. On July 12 at 8:00 A.M. the vessel left Misaki and headed for the fishing grounds. After nine days and nights of sailing the fishing grounds in Area II were reached on July 21 and the search for albacore was begun. Fishing operations were continued for 10 days after which the trials were called off and the vessel headed back to port on July 30. On August 15 at 2:20 P.M. the vessel arrived at Kamaishi where the catch was landed and sold. The catch for this cruise and the proceeds from its sale were as shown in the table of results. On this cruise fishing was done, as indicated by the results of the preceding cruise, in zones of water having temperatures of about 13° at the 50-meter level, but the albacore catch was very small.

Third Cruise

After the completion of the preceding cruise the vessel was docked for repairs to the hull and fishing gear was constructed. On September 21 at 5:10 P.M. the vessel sailed from Kamaishi in Iwate Prefecture and headed for the offshore areas. On this cruise, in view of the results of the preceding two cruises, the vessel proceeded gradually northeastward from the zone of 15° surface temperatures. The lowest temperature in which test fishing was carried out was 13.4°, and in the latter part of the cruise surface temperatures of about 17° were sought. The catch and the proceeds from its sale were as shown in the table of results. Albacore fishing was unexpectedly good in the cold water zones.

4. Conditions on the fishing grounds

(a) Currents on the fishing grounds were in general comparatively slow with the highest velocities encountered about 1 knot and one-half knot the most common. On the first cruise the current was southwesterly one day and easterly the rest of the time. On the second cruise the currents were southeasterly on the eastern side of the survey area and northerly on the

west side with complex lines of discontinuity. On the first half of the third cruise the currents were westerly, but in the latter part of the cruise the lines of discontinuity were complex, the direction of the current was diverse, and good albacore fishing was found.

(b) Water temperature and color

On the first cruise the water temperature and color were extremely favorable. On the second cruise the surface and middle layers had lower temperatures than those encountered on the first cruise; the water color was ordinary. Temperatures ranged from 17.2° to 22.0° on the surface, 11.1° to 15.5° at 50 meters, 9.6° to 13.5° at 100 meters, and 8.0° to 14.1° at 200 meters. On the third cruise the water color was unfavorable, being about 3 to 4. Water temperatures ranged from 13.4° to 17.5° at the surface, 9.2° to 17.5° at 50 meters, 8.1° to 11.5° at 100 meters, and 6.3° to 9.2° at 200 meters.

No albacore were taken on the first cruise, 67 were taken on the second cruise, and the biggest catch, 950 fish, was made on the third cruise. The water temperatures given above were taken at one end of the lines. Observations of the surface temperatures while patrolling the lines showed variations of about 0.2° to 0.5°.

On the second cruise while fishing at 42° 12'N, 178° 45.5'E at the easternmost extremity of this vessel's survey area many schools of small saury [Cololabis saira] were seen. They were being pursued by many schools of albacore, but few were taken on the lines. With salted sardines as bait for pole fishing 11 fish of various sizes were caught, however, it is thought that this probably would have afforded good fishing if live bait had been used.

On the third cruise it appeared that the fish were dispersed over a wide area without relation to the plankton, and as the vessel moved southward the fishing gradually seemed to improve.

5. Schools and signs of life on the sea, relation of the condition of the schools to bait-taking, and the relation of weather and currents to bait-taking

(a) Schools and signs of life on the sea

On the first cruise there were generally few signs of life, only an occasional bird being seen. (Area III was the liveliest with many large schools of skipjack sighted.) During the latter part of the second cruise and during the third cruise there were many birds. The longline catch was better on the third cruise, when no swimming schools were seen, than on the second cruise, when such schools were sighted.

(b) Relationship of weather and currents to bait-taking

Ordinarily better fishing was had when the surface of the sea was rough than when it was calm. Direction of currents had more effect than their speed, and places where the currents were complexly intermingled

appeared most suitable. While this may have been due in part to the rich concentration of plankton, in most cases it was probably that the fish are most stimulated to bite by a moving bait than by a still one.

6. Methods of preserving bait and relationship of freshness to bait-taking

In these operations the baits used were frozen squid (frozen mackerel) and salted sardines. The frozen baits were preserved by operating the refrigeration machinery sufficiently to keep them from thawing. The salted sardines were kept in a separate hold. On the third cruise 7-monme frozen squid were used together with salted sardines on the small hooks as bait for albacore, but their relative effectiveness was not clear. As for the relationship between freshness and bait-taking, in general the fresher the bait the better the catch ratios.

[The table of data on bait has been omitted from the translation.]

7. Sizes of the largest and the smallest albacore taken, and the type of school and the average size of fish taken in the biggest single catch

The largest fish taken was 1 meter long and weighed 27.2 kg. The smallest was 44 cm long and weighed 2.46 kg. The biggest single catch was 165 fish. The largest was 1 meter long and weighed 27.2 kg; the smallest was 47 cm long and weighed 2.86 kg; the average was 73.2 cm long and weighed 8.11 kg.

8. Method of handling and preserving the catch

Large fish such as big-eyed tuna and marlin were opened up as soon as they were caught and the gills and viscera were removed. Albacore and other small fish were stowed in the round. The fish were all thoroughly washed with sea water, the large ones were wrapped in cloth, the albacore were wrapped in waxed paper, after which they were laid on the racks in the fish-holds and covered with enough crushed ice so that the fish could not be seen. The refrigerators were operated sufficiently to keep the ice from melting.

9. Place and method of sale and proceeds

The catch was sold at Misaki in Kanagawa Prefecture and at Kamaishi in Iwate Prefecture. The prices and the value of the landings are given in the summary table of the results of operations.

10. Summary table of the results of operations [Omitted. See Tables 4 and 5.]

11. Opinions concerning vessels, gear, methods, grounds, and season

(a) With regard to the fishing vessel, since it should be economical and efficient because of the large number of days required for going to and from the fishing grounds, the best type should be a boat of the 100-ton class with capacious fishholds and thoroughly adequate refrigeration facilities. Large-scale operations of the mothership type should also be suitable.

(b) The albacore longlines were made of No. 10 cotton line with 11 hooks (3 large and 8 small) per basket. The trunk lines were formed of 12 15-fathom lengths of 7-momme line giving a total length of 180 fathoms. The branch lines for the large hooks were 7 fathoms long and were made of 9-momme line. The branches for the small hooks were of 6-momme line and were 2.5 fathoms long. The sekiyama for the large branches was 3 fathoms long and was made up of No. 23 wire wrapped with No. 4 cotton. The wire leaders for the large hooks were of No. 28 wire and were 1.8 fathoms long. For the small hooks the sekiyama was made up of No. 29 wire served with No. 2 cotton and was 2 fathoms long. Wire leaders for the small hooks were No. 29 or No. 30 wire 1.8 fathoms long. The hooks were all tinned iron, the large ones 4 sun 2 bu / 5.04 inches / and the small ones 2 sun 8 bu to 3 sun 2 bu / 3.36 to 3.84 inches / long. At the upper end of the sekiyama of the large hooks and at the upper end of the wire leader of the small hooks large and small brass swivels respectively were attached. The float lines were 7-momme Manila 15 fathoms long. The floats used were glass balls 10 inches in diameter.

This a general description of the gear, but float lines of various lengths were used depending on the water temperature at the middle levels and the depth at which the schools were swimming. On the first cruise they were 15 fathoms long, 10 fathoms on the second cruise, and 5 fathoms on the third cruise. There is still room for further research on this point.

(c) Fishing methods, fishing grounds, fishing seasons

For offshore albacore fishing in the summer season longlines should be the principal method with pole and line and trolling as the auxiliary methods. Area I is a suitable area and all research vessels should be assigned to operate there. Viewing the total results of this investigation, it appears that in summer the albacore schools keep to zones of fairly low temperature water. The first and second cruises were made somewhat too far south. During the latter part of the third cruise the catch ratios were average and the fish weighed as much as 3 kan 580 momme / 29.61 pounds /. There was, however, a tendency for the fish to move from north to south. The results outlined above make it thought that the season extends almost throughout the whole year.

Report of Results of Albacore Fishing Ground Development

Kanagawa Prefecture Fisheries Experiment Station, Misaki Branch

1. Vessel - Sagami Maru
2. Type of operations - Albacore fishing grounds exploration
3. Outline of operations

Survey area	Area III
Date operations began	May 13, 1939
Date operations ended	October 20, 1939
First cruise	May 16 to June 10 Asst. Tech. Tamura aboard
Second cruise	June 17 to July 14 Asst. Hattori aboard
Third cruise	Aug. 26 to Sept. 22 Asst. Tech. Tamura aboard
Fourth cruise	Sept. 26 to Oct. 16 Asst. Hattori aboard

Note: On the fourth cruise there was a case of sudden illness among the crew and the vessel was obliged to break off operations after four stations had been fished and return at high speed to port.

4. Conditions on the fishing grounds

First Cruise

The area investigated on this cruise was between 32° 50' - 36° 30'N and 165° 30' - 173° E. Distribution of water temperatures was such that as the vessel proceeded eastward lower temperatures were encountered. In the vicinity of 172°E, 36° 50'N a point where warm and cold currents mingled was perceived. Within five to 10 miles to the east and north the temperature fell by about five degrees and the water color became unfavorable. The direction of the current was variable and only gentle currents were detected. Water temperatures were 17° to 19° at the surface, and 15.8° to 17.7° at 50 meters.

Second Cruise

The area surveyed was between 35° - 38° 30'N and 164° - 174° 40'E. On this cruise the line of 17° surface temperatures was seen to extend WNW and ESE from the vicinity of 37°N, 169°E. Water temperatures in the operating area were 16.4° to 19.5° at the surface, and 14.2° to 18.7° at 50 meters. Transparencies were 14 to 22 meters and gentle northeasterly currents were observed.

Third Cruise

The area surveyed was between 40° 30' - 44° 20'N and 166° 20' - 173°E. In the western part of this area the water temperatures were comparatively high, but as the vessel proceeded eastward within the area the temperatures generally dropped, especially marked changes being measured at the 50-meter level. Water temperatures in the survey area were 17.7° to 22.5° at the surface, and 9.5° to 15.5° at 50 meters. Transparencies were 16 to 26 meters and there were gentle northerly currents on the surface.

Fourth Cruise

The survey area was between 42° 22' - 44° 24'N and 163° 30' - 169° 34' E. Temperatures were 14.3° to 16.7° at the surface, and 7.1° to 11.7° at 50 meters. The water color was rather unfavorable, transparencies were from 10 to 18 meters. No current was perceived.

5. Relationship of weather and currents to schools and bait-taking

Throughout all four cruises few albacore were taken and few data are available so the fishing situation cannot be made clear, however, judging by the area covered by this year's investigations the catch rates appear to be better when the sky is overcast and there is some wind and a sea running. During the whole period of the investigations no albacore school was seen at the surface, and the catch on the longlines was sparse. On the fourth cruise there were some sets where the catch rate was comparatively good, but the catch was spotty and it appeared that the schools were small. On the fourth cruise some fish were taken on the trolling lines, but the schools were sparse and the fish did not take the bait well.

6. Methods of keeping bait and relation of freshness to bait-taking

Three types of bait were used - frozen squid, frozen sardines, and salted sardines. The squid were kept in containers holding 80 to 100 and were placed under the ice in the ice boxes. The frozen sardines, which were packed 200 to the box, were similarly stored. The salted sardines, in containers of 200 or 300 fish, were stowed in deck lockers. Because of the lack of refrigeration machinery on this vessel, over a long period of time the frozen squid and sardines came to be in a poor state of preservation. The squid could be used for about 20 days after leaving port but they could not be prevented from turning red. The frozen sardines did not keep well on a long voyage. Their bellies burst and they were not as effective in actual use as the salted fish, however, it is thought that they are more attractive to the fish than are salted sardines.

[A table of data on bait is omitted here.]

7. Sizes of the largest and smallest albacore taken (weights, lengths) and the number and average size of the fish taken in the biggest single catch

The largest fish taken was 3 shaku 6 sun 5 bu [3 feet, 4.2 inches] and weighed 7 kan 800 momme [64.81 pounds]. The smallest was 1 shaku 6 sun 5 bu [1 foot, 6.6 inches] long and weighed 900 momme [7.4 pounds]. The biggest single catch was 47 fish, the average weight of which was 5.8 pounds and the average length of which was 1.7 feet.

8. Methods of handling and preserving the freshness of the catch

Immediately after capture the albacore were wrapped in sulfite paper and muslin and stowed with ice in the ice-boxes. Other tunas were opened up and gutted immediately after capture. They were then washed, wrapped in sulfite paper and muslin and stowed in ice.

9. Place and manner of sale

Place of sale - Misaki-machi in Kanagawa Prefecture
Manner of sale - Sold by written bid at the Misaki fish market

10. Summary table of the results of operations [Omitted from the translation.]

11. Opinions concerning vessels, gear, methods, grounds, and seasons

The results of two years of investigations indicate that fishing boats which take part in the summer albacore fishery must have great cruising range. They must be able to operate at least 4,000 miles off shore and to remain on the grounds for 15 days or more. For these reasons vessels of the 250-ton class or larger would be ideal.

It is believed that with large vessels there would be no limit to the fishing season, however, for vessels of 200 tons or smaller it is believed that the period from the latter part of August to the latter part of October will be the most suitable fishing season since it appears that during this period the schools tend to move into the western part of the North Pacific.

The results of investigations in Area III indicate that since the albacore are generally small, better catch rates are had using small hooks. Hooks 2 sun 8 bu [3.36 inches] or less in length seemed to be suitable, however, it has not been possible on the basis of the data from two years' investigations to determine whether or not many small albacore migrate into Area III. Furthermore it appears that more study is required with regard to the size and length of trunk lines and branch lines, the length of float lines, and so forth.

12. Other items considered necessary

Since the distribution of water temperatures in the areas covered by the exploration of albacore fishing grounds is extremely complex, it appears that one help toward the attainment of the objectives of these surveys would be for the fisheries guide vessels to maintain a close radio liaison with each other in order to transmit information concerning the distribution of temperatures at the 50-meter level and other essential items which might serve as data for the selection of fishing grounds.

Report of Results of Albacore Fishing
Ground Development

Mie Prefecture Fisheries Experiment Station

1. Vessel - Kamui Maru
2. Type of operation - Albacore fishing ground exploration
3. Outline of operations

First Cruise

At 8:30 A.M. on June 10 the vessel sailed from Hamashima and headed for Misaki in Kanagawa Prefecture to take on bait and ice. She arrived at Misaki the following day, the 11th, at 5:30 A.M. and loaded 30.8 tons of ice, 12,550 salted sardines, and 2,960 frozen squid. At 10:05 P.M. the anchor was weighed and the vessel headed for the fishing grounds for the first phase of the survey. With a following wind and a calm sea the fishing grounds were reached on the 19th and operations were immediately begun. Fishing continued for 10 days and on the 29th the vessel began its return voyage, arriving at Misaki on July 6 at 8:18 A.M.

Second Cruise

On July 8 8,100 salted sardines, 2,000 frozen squid, 1,500 frozen saury, and 25.1 tons of ice were taken aboard and at 11:00 P.M. the vessel weighed anchor and departed Misaki for the second cruise. The fishing grounds were reached on the 15th and operations were begun at once. The vessel operated for 8 days between 164° - 170°E and 37° - 39°N. The return voyage was begun on the 23rd and she arrived back at Misaki on July 31.

Third Cruise

On August 25 at 10:00 P.M. the vessel sailed from Misaki for her third cruise. There were 2,000 frozen squid, 1,500 frozen saury, 11,000 salted sardines, and 28 tons of ice aboard. The vessel arrived on the fishing grounds on September 1 and began operations on the 2nd. Fishing was carried on for 13 days between 166° and 171° E. During the first part of this period the vessel operated in the vicinity of 43°N, but later she moved south and fished between 40° and 41°N. The return voyage was begun on the 19th with arrival at Misaki on September 28.

On this cruise the line-hauler broke down on the first day of operation and, there being no prospects of repairing it, the lines were thereafter hauled by hand. For this reason four of the 17 days spent on the fishing grounds were devoted to resting. On this cruise the first albacore, 19 fish (three of them shark-eaten), were taken.

Fourth Cruise

On October 2 2,990 frozen squid, 10,150 salted sardines, and 27.6 tons of ice were loaded and at 4:30 P.M. the anchor was weighed and the vessel headed for the fishing grounds. She arrived on the grounds on October 10 and commenced fishing immediately. Fishing was carried on for

4 days in the vicinity of 163° - 164°E, 43° - 45°N after which the vessel moved south and operated in the area around 38° - 42°N, 166° - 169°E. The vessel fished for 12 days and the return voyage was begun on the 23rd with arrival at Misaki on October 31. The line-hauler broke down on this voyage also and the lines were hauled by hand so that out of 14 days spent on the grounds 2 days were devoted to rest. On this cruise 420 albacore were taken.

4. Conditions on the fishing grounds

First Cruise

Fishing was done between 164° - 168°E and 33° - 35° 30'N. Surface water temperatures in this area ranged from 18° to 20° and the difference from the temperatures at the 200-meter level ranged from 2.2° to 6.3°. At the same time last year (first cruise) the difference between the surface temperature and that of the 200-meter level was 2.1° to 4.8°. This year the temperatures at the lower levels were generally low. During operations the currents were practically uniformly SE - ESE with velocities of about 1 knot. The water color was favorable and transparencies were 20 - 28 meters.

Second Cruise

Surface water temperatures on the fishing grounds showed no great difference from those of the previous year at the same season, ranging from 19° to 23°. The difference between the temperatures at the surface and at the 100-meter level was 9° - 10°. The currents were mainly E to ESE with velocities of about 1 knot. In the vicinity of 165° - 166°E, 37° - 38° 30'N there were many lines of discontinuity, but the surface was generally calm. Driftwood was seen from time to time around 37° 50'N, 168° 20' - 50'E and there were many schools of dolphin. While patrolling the lines large schools of skipjack were occasionally seen. These fish took the bait extremely well and in three attempts at fishing them with salted sardines for chum and artificial lures on the hooks 5,000 fish were taken.

Third Cruise

In the operating area between 166° - 171°E and 40° - 44°N the water color was generally unfavorable with a whitish tinge. Surface temperatures were 17° to 21° and the currents were gentle. East of 169° there were NNE - ESE currents with velocities of about 1 knot. In the areas in which the vessel operated west of 169° almost no currents were perceptible.

Fourth Cruise

In the operating area around 163° - 164°E, 43° - 45°N the water was generally whitish and the currents were extremely gentle with a N - NE direction. Water temperatures were 15° - 18° on the surface and 10° - 12° at 50 meters, with differences between the two levels of 4° - 6°. Transparencies were from 19 to 22 meters. Farther south around 166° - 169°E, 38° - 42°N the water color was generally favorable and the currents were

practically imperceptible. Surface water temperatures were 17° - 20° and the differences from the temperatures at lower levels were comparatively slight. Transparencies were generally great, reaching 23 - 27 meters.

5. Relationships of weather or currents to schools and bait-taking

No albacore were taken on the first and second cruises. On the third cruise 19 albacore were caught (three of them shark-eaten), and on the fourth cruise 420 were taken. There were no clear days durin, fishing operations on the third cruise. Of the six days on which fish were caught, three days were half-clear and three days were overcast. The relationship between weather and bait-taking is not clear because the catch was so small.

Of six days when fish were caught there was an ESE current one day, NNE currents on three days, and practically no current on the other two days. The results of this cruise make it appear that the albacore are most plentiful north of 43°N, and the catch ratios were best where the surface temperatures were around 17° and those at 50 meters around 8°. On the fourth cruise a total of 420 albacore were taken, most of them on cloudy days, with clear and rainy days next best in that order. On a percentage basis cloudy days accounted for 65% of the whole catch. There were no bright clear days on this cruise. Practically no current was perceptible during fishing operations. Albacore were abundant in the vicinity of 163°E, 43°N.

6. Methods of keeping bait and the relationship between freshness of bait and bait-taking

The baits employed were salted sardines and, for the large hooks, frozen squid and saury. They were all stowed in the original boxes in the fishholds and were packed in crushed ice. The required amount of bait was taken out each time it was to be used, and the bait remained comparatively fresh. The relation of the freshness of the bait to its acceptance by the fish is not clear, however, the results of using bait made from frozen squid indicate that the fresher it is the better the fish bite on it. Frozen saury were tried for use on the large hooks, but compared to frozen squid the catch ratios were poor and the lines were brought in with the baits almost untouched.

[A table of data on bait is omitted from the translation here.]

7. Sizes (length, weight) of the largest and smallest albacore taken and the number and average size of the fish taken in the biggest single catch

Largest	1 meter long	15.750 kg
Smallest	48 cm long	2.437 kg

The biggest single catch was 200 fish, the average weight of which was 3.575 kg.

8. Handling and preservation of the catch

The albacore were individually wrapped in waxed paper after capture

and stowed in ice in the fishholds. Other tunas were opened up and gutted immediately after capture, then washed, filled with ice, wrapped in muslin, and stowed in ice in the fishholds.

9. Place and manner of sale

The catch was auctioned by written bids at the municipal fish market at Misaki in Kanagawa Prefecture.

Proceeds of sale	First Cruise	¥ 1,028.13
	Second Cruise	2,879.84
	Third Cruise	3,334.07
	Fourth Cruise	2,642.88
	Total	9,884.92

10. Summary table of the results of operations [Omitted from the translation. See Tables 4 and 5 earlier.]

11. Opinions concerning vessels, gear, methods, grounds, and seasons

a. Fishing vessels

For operating in Area III a vessel of the 130-ton class is suitable. It must have fuel and water tanks which give a cruising range sufficient for the trip out and back and 10 - 15 days of operation on the grounds. Because the fishing takes place during the summer and the cruises are long, there is considerable loss of ice by melting so naturally good insulation is necessary.

b. Fishing gear

When the gear was put into actual use, the following changes in the disposition of the branch lines were made on last year's gear:

Last Year	This Year
2 large branches	3 large branches
9 small branches	6 small branches
ramie leaders on small hooks, 30 strand	No.29 wire leaders on small hooks, 9 strand

With the trunk lines of longlines water resistance is a consideration to some extent, but if strong Manila line is used with only the branch lines being made of 8 - 10 momme cotton the line should be satisfactory. For catching albacore, branch lines of 6 momme cotton are adequate. Last year the leaders for the albacore hooks were made of 36 strands of ramie, but they were broken in many cases by small big-eyed tuna so this year they were replaced with nine strands of No. 29 wire twisted together. It is thought best to use coal tar dye with only the cotton branch lines being dyed with cutch. On all of the cruises the float lines were adjusted to lengths of 8 or 12 fathoms, and "chemical tubes" were attached at the lower end of the sekiyama of the large hook branch at the center of each trunk line to measure the depth. The depths

ranged from 56 to 83 meters and were commonly around 70 meters, but the depth appeared to make no great difference in the catch. A graph was drawn on the basis of these "chemical tube" depths to show the hypothetical depths of the albacore hooks. An attempt to find the water temperatures near these hooks from the measured vertical distribution of temperatures gives the following results:

[A table is inserted here; see next page of translation.]

Judging from these data the most fish are taken in waters of 8° to 13° temperature, and it can be seen that the albacore's habitat covers waters of rather low temperature. (See appended tables)

c. Fishing methods

On the third and fourth cruises, when albacore were taken, most of the fish were caught on longlines. Pole fishing was tried only two times on the fourth cruise (taking 114 and 16 fish). The trolling lines took 18 fish on October 11 and 4 fish on the 13th. In the previous year's investigations live bait was carried, but this year, in order to increase the ice-carrying capacity, none was taken along. Salted sardines were adequate for pole fishing, but it is thought that better results would have been obtained with live bait.

d. Fishing grounds

It would be of great value in fishing if it were possible to have a knowledge of oceanographic conditions on the fishing grounds throughout the whole operating period. Therefore it is thought that it would be of great benefit to the planning of operations if arrangements could be made to have each vessel enter detailed notes concerning the surface water temperatures on its track chart for each cruise, appending a table of observations, and transmit this information rapidly to the fisheries experiment stations of each of the cooperating prefectures.

e. Fishing seasons

The period from May to October in which this year's survey was carried out is suitable, but if possible it would be desirable to start out in April so that the boats could be on the fishing grounds inthe early part of May. The necessity for this is seen in the fact that even in Area III the Musashi Maru and the Sagami Maru took a fair number of albacore in May. These are considered to be the remnants of the winter albacore, but it appears necessary to investigate the migrations of the albacore during the period between the winter season and May.

In the course of the Kamui Maru's operations in the middle of October it appeared from the fish themselves and from the oceanographic conditions that the fish taken in the first part of the operations were summer albacore while those taken in the latter part of the cruise when the vessel moved farther southward were winter albacore. For example, the fish taken in the first part of the operations were small (it may be premature to judge that all small fish are summer albacore, however, this is assumed

[Table of Estimated Depths at Which Albacore Were Taken]

Cruise	Date	Length of Float Lines	Depth of Chemical Tube	Depth Range of Albacore Hooks	Water Temperature at Position of Hooks	Albacore Taken
		fathoms*	meters	meters	degrees	fish
Third	9-2	12	75.7	40.9 - 62.1	8.0 - 9.5	11
"	9-6	8	67.8	34.8 - 50.0	7.9 - 9.3	3
"	9-8	8	75.8	37.8 - 57.5	19.3 - 20.4	2
Fourth	10-10	8	83.3	42.4 - 63.6	11.6 - 13.1	34
"	10-13	8	56.0	30.0 - 37.8	10.8 - 11.7	32

[*Japanese fathoms = about 5 feet]

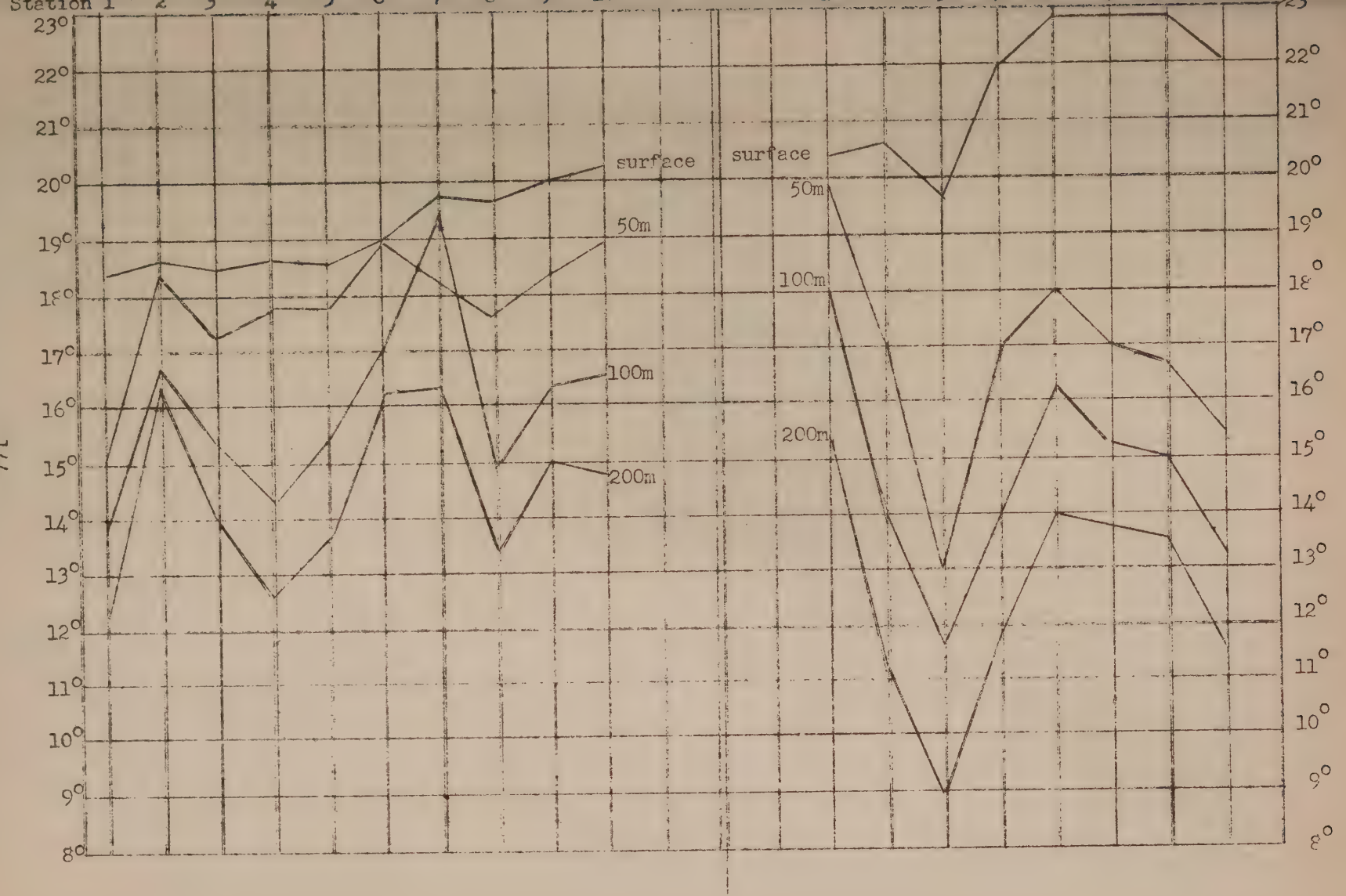
on the basis that these fish were of the same size as those taken on the third cruise) and they were taken in waters where the water color was bad and the differences between the temperatures at the surface and at the 50, 100, and 200 meter levels were great. During the latter half of the operations the water color was generally favorable, the difference between the water temperatures at the surface and at lower levels was small, and the oceanographic conditions resembled those found on the winter tuna grounds (see the appended table of the vertical distribution of temperatures on winter tuna grounds). What was attempted was to carry on operations covering the end of the summer albacore and the beginning of the winter albacore as well as both fishing grounds (north and south).

There follows an example of the vertical distribution of water temperatures on the winter albacore grounds (taken from observations made aboard the Kamui Maru in 1937 and 1938).

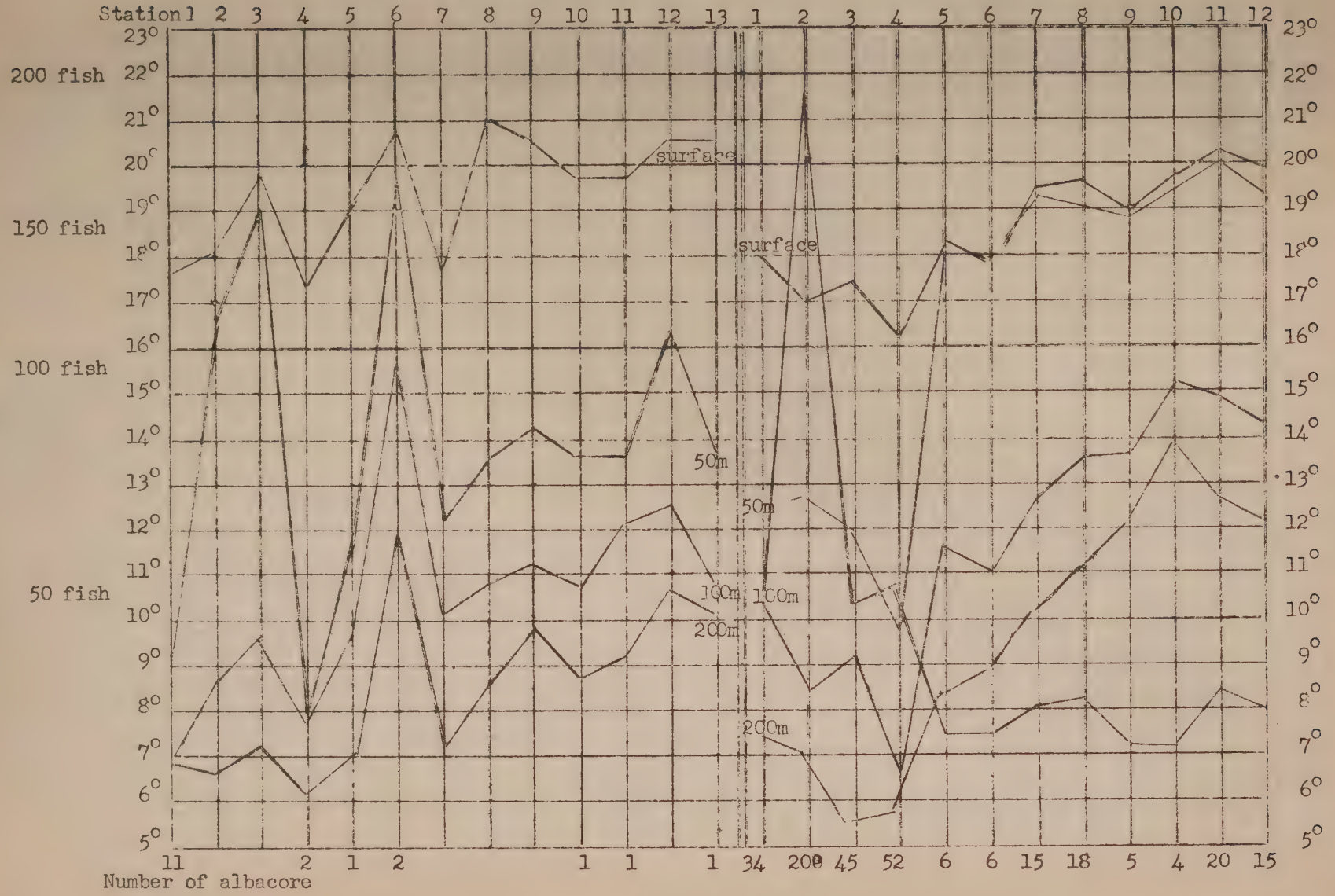
[Four graphs of the distribution of surface water temperatures have been omitted here because the curves were not clearly identified.]

[Vertical Distribution of Water Temperatures on Albacore Grounds]

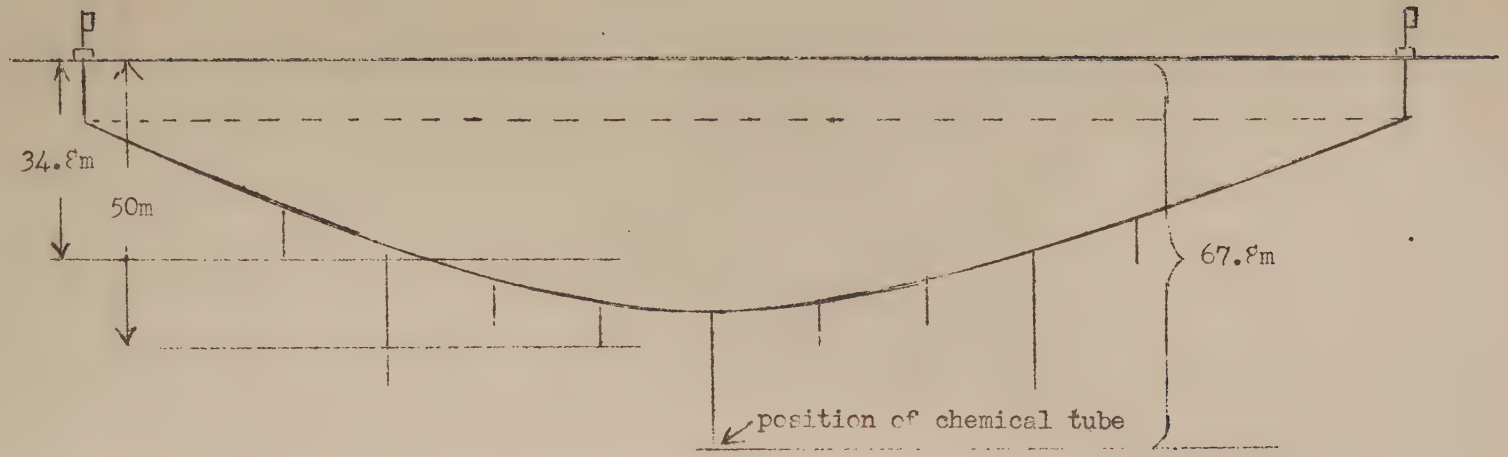
Date	Fishing Ground	Surface Temperature	Temperature at 50m	Temperature at 100m
		1937		
12-18	159°48'E, 35°31'N	16.7°	16.5°	16.4°
12-19	159°48'E, 35°31'N	17.3	17.2	16.4
12-20	165°02'E, 36°35'N	18.2	18.2	18.0
12-21	165°34'E, 37°28'N	18.4	18.4	18.1
12-22	165°25'E, 37°15'N	17.6	17.3	16.7
12-23	165°52'E, 37° 32'N	17.8	17.8	17.3
12-24	165°18'E, 36°50'N	17.8	17.2	16.7
12-25	163°00'E, 36°00'N	18.0	18.2	18.2
12-26	162°42'E, 34°54'N	18.1	18.1	18.0
12-27	154°10'E, 34°54'N	18.3	18.2	18.0
		1938		
10-14	166°12'E, 34°26'N	19.1	19.1	19.1
10-15	166°26'E, 34°32'N	19.1	19.1	19.0
10-16	165°35'E, 34°35'N	18.4	18.2	17.8
10-17	166°37'E, 35°07'N	18.1	17.6	17.1
10-18	166°00'E, 34°45'N	18.8	18.2	18.0
10-19	166°25'E, 34°55'N	19.0	19.1	18.6
10-20	166°24'E, 34°59'N	19.0	18.9	18.2
10-21	166°48'E, 35°25'N	18.4	17.8	17.9


Station 1
23°
22°
21°
20°
19°
18°
17°
16°
15°
14°
13°
12°
11°
10°
9°
8°
surface
50m
100m
200m
surface
50m
100m
200m
144

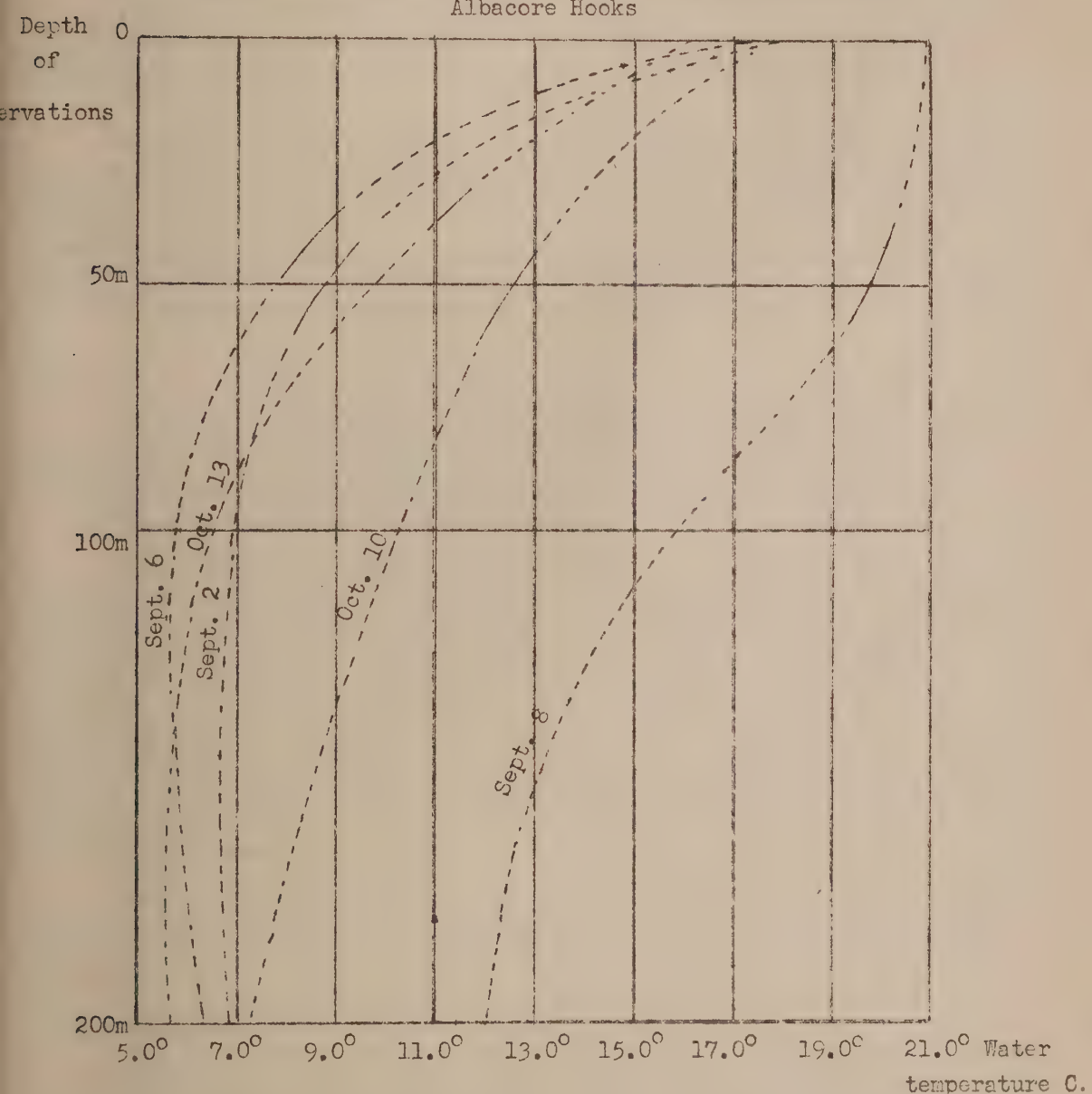
Vertical Distribution of Temperatures on the Fishing Grounds No. 2



Plan of the Assumed Positions of Albacore Hooks (example of September 6)



Graph of Assumed Water Temperatures at the Positions of Albacore Hooks



Report of Results of Albacore Fishing Ground Development

Tōkyō District Fisheries Experiment Station, Ōshima Branch

1. Name of vessel - Musashi Maru
2. Type of operation - Albacore fishing ground exploration
3. Outline of operations

Repairs to the hull were begun early in April. All haste was made, but because of the current situation the work took an unexpectedly long time. Preparations for fishing were at last begun on May 5, and in the 159 days before everything was secured on October 10 four cruises were made. Beginning on May 5 the fishing gear was assembled, dried, and dyed. On May 10 bait and ice were taken aboard and the compass error was measured. On May 11 the vessel departed Misaki for its first cruise.

First Cruise

The vessel sailed seven days and nights after leaving Misaki and arrived on May 18 on the fishing grounds of Area III where it immediately began fishing operations. The position of the first ground fished was 30°N, 165° 46'E, but no albacore were taken there so the vessel proceeded on a course to the northeast searching for suitable water temperatures.

Later at 35° 37'N, 172° 09'E eight albacore were taken, after which the vessel continued to seek suitable water temperatures. On May 23 in an area with a surface temperature of 17° a school accompanied by countless birds was seen, and since the fish bit on the trolling lines, longline operations were immediately begun. While patrolling the lines albacore were seen swimming near the surface. They were chummed in to the boat with salted sardines and 112 fish were taken with poles. When the lines were hauled in there were 124 fish on them, making a total of 236 fish. It is thought that if live sardines had been available several thousand albacore could have been taken at once, and it is extremely regrettable that no live bait was carried.

Later operations produced no albacore and after 11 days of fishing the vessel turned back, reaching Habu Harbor on June 8. The vessel arrived back at Misaki on June 9, sold its catch, and then began to repair fishing gear.

Second Cruise

With the gear all in order and bait and ice loaded aboard, the vessel sailed from Misaki on June 15 and after putting in at Habu Harbor proceeded straight to the fishing grounds. The fishing grounds in Area III were reached on June 23 and thereafter fishing continued for 11 days. There was generally little change in temperature on the fishing grounds. Operations were halted on July 7 and the vessel began its return voyage. After steaming for seven days and nights, the vessel reached Misaki on July 14 where it landed and sold its catch.

Third Cruise

After the completion of the preceding cruise the fishing gear was put in order and repairs were made to the hull. On July 21 ice and bait were taken aboard and the following day the vessel sailed from Misaki. Bad weather was encountered off Nojimasaki and the vessel took refuge temporarily at Tateyama. On the 24th she left Tateyama and headed directly for the fishing grounds, arriving on the fishing grounds in Area III after seven days and nights of steaming. At first the vessel proceeded northward from 39° 38'N, 163° 18.5'E on a north-by-east course in search of zones of suitable water. Many birds were seen at 44° 03'N, 164° 10'E and the lines were immediately set, but there was no catch other than some sharks [Isurus nasus]. A set was made on August 2 at 42° 25.5'N, 165° 23'E, but just as in the preceding set only Isurus nasus were taken. Seven more stations were fished between 42° and 38° 39'N after which the vessel began its return voyage on August 10. After steaming for ten days and nights she arrived on August 23 at Misaki where the catch was landed and sold. On the way back a low of 742 mm was encountered at 36° 20'N, 152° 49'E and the vessel put out a sea-anchor and remained hove to for 24 hours.

Fourth Cruise

After returning from the preceding cruise, repairs were made to the fishing gear. On August 28 ice and bait were taken aboard and on the 29th the vessel departed the Misaki base for the fishing grounds. After seven days and nights of steaming she arrived on the fishing grounds of Area III and began fishing September 6 at 43° 15'N, 167° 19'E with a water temperature of 17°. Thereafter seven fishing trials were made in the area between 43° and 44° 20'N and 167° 2.5' and 174° 33'E with surface water temperatures of 15.5° to 17.5°, however, the albacore catch was not very good. Finally trials were made at 40° 43'N, 170° 40'E and at 40° 41'N, 170° 51'E, and then on September 17 operations were ended and the vessel began its return voyage. She arrived back at Misaki on September 28 and on the 29th the catch was landed and sold. During the trip back signs of an approaching typhoon were encountered at 37° 33'N, 152° 56'E and the vessel hove to. After reaching Misaki repairs were made to the fishing gear, and on October 10 the albacore fishing experiments were at an end.

4. Conditions on the fishing grounds

First Cruise

In the area covered by this cruise the surface temperatures ranged from 17° to 18.1°. The maximum variation between temperatures at the surface and at 50 meters was 2.5° with an average of 1.6°. Currents were generally weak, with a maximum velocity of 1.5 knots and no strong currents. On the fishing grounds the currents were somewhat complex and lines of discontinuity were encountered from time to time.

Second Cruise

On the fishing grounds of this cruise the surface temperatures ranged from 18.4° to 22°. A search was made for suitable water, but there was

little variation in temperatures and the greatest difference between the surface and the 50-meter level was only 3.4°. Currents were strong and their general direction was northeasterly.

Third Cruise

At the beginning of this cruise the vessel proceeded from 39° 38'N on a north-by-east course in search of suitable water. North of 43°N the water temperature fell sharply, there were few zones of suitable 17° to 18° water, and cold zones of 13° to 15° water predominated. The effect of the cold currents was thought to be great.

Fourth Cruise

The currents were gentle on the grounds between 43° and 44° 30'N and 167° and 174°E and only a slight northeasterly flow could be detected. A search for suitable water was made, but few variations in temperature were encountered.

5. Schools and signs of life on the sea, relationship between the types of schools and bait-taking, and the relationship between weather and current and bait-taking

On the first cruise many flocks of birds were seen at 36° 25'N, 172° 29'E in an area with a 17° surface temperature. The lines were immediately set, and while patrolling them a school was seen swimming close to the surface. An attempt was made to fish the school with poles, but the fish were moving fast and salted sardines were used for bait, there being no live sardines aboard, and as a result it was impossible to hold the school alongside for any length of time. On the other cruises few birds were sighted and no albacore were seen in the water. The currents at the surface and at the level at which the fish were swimming were not the same, and therefore even when a good fishing ground was once discovered it was extremely difficult to know how far to go and in what direction in order to set the lines on the following day.

6. Methods of keeping bait and the relationship between freshness and effectiveness of bait

Before sailing the insides of the fishholds were thoroughly cleaned and clean straw mats were spread in them. Approximately the lower one-third of a hold was then filled with crushed ice and the boxes of frozen squid were stowed on top of this layer. More crushed ice was heaped on top of the bait to a level of about two-thirds of the capacity of the hold. The boxes of salted sardines were then placed on top of this layer and carefully covered with several layers of straw mats. The inner and outer hatch covers were put on and covered tightly with a tarpaulin so that no sea water could leak in. There was, however, considerable loss of ice by melting, and at the end of the survey the icebolds were inspected and found to need repairs. When the vessel was undergoing repairs, the rotten portions of the partitions were replaced and the inadequately insulated places were all fixed.

[A table of data on bait has been omitted from the translation here.]

7. Sizes (weights, lengths) of the largest and smallest albacore taken, and the number taken in the largest single catch

Largest	21.38 kg	1.03 meters	taken May 22
Smallest	4.31	0.47	taken May 23

The largest single catch was made on the first cruise on May 23 when 236 fish with an average weight of 9.8 kg were taken.

8. Methods of handling and keeping the catch

The fish were thoroughly cleaned and the dirt removed from the outside of them. They were then wrapped in waxed paper and packed in crushed ice in three tiers so that they were completely covered with ice. Boards were placed between the layers of fish to keep them from pressing on each other and to give the ice a chance to work most effectively.

9. Place, proceeds, and manner of sale

The catch was sold at Misaki in Kanagawa Prefecture at auction by written bid. The total value of the landings from all four cruises was ¥ 10,010.39 and the total proceeds realized were ¥ 9,309.69.

10. Summary table of the results of operations [This table has been omitted from the translation. The essential data appear in Tables 4 and 5.]

11. Opinions concerning vessels, gear, methods, grounds, and seasons

a. Fishing vessels

Since the vessels are to operate in distant waters, the first principle is that they should be strong. The period covered by this survey was a comparatively calm season and there was little fear of danger from bad weather, but the fishing grounds are about 1,600 miles from the base, and it requires over 16 days for the trip out and back so the boats must be correspondingly equipped with cargo capacity and facilities for the preservation of the catch so as to be able to increase the number of days spent in operations on the fishing grounds. Accordingly the capacity of the fuel tanks must be increased and the insulation of the fishholds must be perfected. In view of these facts, the Musashi Maru was provided with as much additional fuel capacity as her hull could stand without being weakened and the icehold which had the poorest insulation was repaired. It is thought that ideally the vessel should be of 180 tons with 360 horsepower and, since the operating period is during the summer, she should be equipped with effective refrigeration machinery.

b. Fishing gear and methods

The main fishing gear is the longline, but pole-fishing and trolling gear should be prepared for use, particularly as it sometimes happens that dense schools swim near the surface and can be advantageously fished with pole and line methods. On vessels like this one, however, there is the drawback that because of the small capacity of the holds, when live

bait is carried the amount of ice which can be carried for preserving the catch is diminished.

c. Fishing grounds and seasons

The best fishing grounds are probably those where the surface temperature is 17° and the temperature at 50 meters is about 11°, but the range of migration is limited to small scattered areas and the schools are small. It is thought that at times the schools congregate densely near the surface and at times they come to the surface in pursuit of squid and small fish. The schools swim at rather high speeds and it is believed that it would be most effective to chum them in to the boat and fish them with poles, however, since the range of occurrence of the schools is small some difficulty is found in searching for them. As for the fishing season, it is thought that the designated operating period is adequate.

(4) Summary

(A) General Aspect of the Distribution of Water Temperatures and Specific Gravities (see Charts of Monthly Isotherms and Isotones) from the First Ten Days of May On

Operations were begun May 18 and during the month of May the operating vessels covered the whole area, with 5 vessels between 32° and 37°N. This was about 4° of latitude farther north than the operating area of the previous year. The surface water temperatures ranged from about 17° in the north to about 20° in the southern part of the area, or a slope of about 3° in 6° of latitude. This was about twice as gentle a slope as was seen in the previous year. Just as in the previous year, the temperature profiles in the eastern and western parts of the area were roughly parallel. The zones of 17° - 19° water appeared to follow roughly the line of 35°N. As for the vertical distribution, the temperatures at 50 meters were 2° lower than those at the surface, those at 100 meters were 1° lower than those at 50 meters, and those at 200 meters were 1° lower than those at the 100-meter level. At each level the north-south and east-west profiles had roughly the same slope as the surface temperatures. The distribution of specific gravities in the surface waters was lower in the north with a figure of 2600 in the southern part of the area. At the 50-meter, 100-meter, and 200-meter levels the lowest values were in the east, with 2540 to 2580. In the southern part west of about 170°E values of 2620 were obtained and differences were seen between the surface waters and those below the 50-meter level.

June

Eight vessels were in operation during this month and they covered roughly the area between 32° and 38°N. Surface temperatures in these waters ranged from about 17° in the north to 19° - 20° in the south, showing a slope of about 3° in 6° of latitude. When compared with the water temperatures at the same latitudes in the last 10 days of the previous month, they showed a rise of about 1°, and the zone of 17° - 19° water had moved northward about 2° of latitude from its position of the

preceding month so that it was distributed in the vicinity of 37°. Except for some complexities in the neighborhood of 167°E and 176°E, the isotherms ran approximately parallel in an east-west direction.

Temperatures at the 50-meter level were about 2° lower than those at the surface. No great complexity was seen at this level; the slope was 4° of temperature in 4° of latitude, and the east-west profiles were roughly parallel.

At the 100-meter level the temperatures were about 2° lower than those at the 50-meter level, and there were some complexities in the vicinity of 178°E. The slope was 2° in 3° of latitude and the east and west profiles were approximately parallel.

Temperatures at the 200-meter level were about 1° lower than those at the 100-meter level and the slope was generally the same.

As for the distribution of specific gravities, at the surface there was a boundary at about 35°N, north of which the values were low, with a figure of 2550, while to the south higher values to 2600 were found. The distribution at the 50-meter, 100-meter, and 200-meter levels was roughly the same as that at the surface, but at the 50-meter level water with the rather high chlorinity of 2620 was encountered east and west of 170°E.

July

Eight vessels were in operation during the month and they covered the area between 33°N and 43°N in Areas I and II, while in Area III they were between 34°N and 40°N. In Areas I and II the surface temperatures ranged from 17° in the north to 22° in the south for a slope of 5° in 10° of latitude. The zones of 17° - 19° water showed a rapid northward movement of about 5° from their position of the previous month, placing them in the vicinity of 42°N. In Area III the surface water temperatures were 20° - 21°, somewhat higher than at the same latitudes in the other two Areas.

At the 50-meter level the temperatures showed a marked drop of 5° - 6° from those at the surface. In Areas I and II the slope was a gentle one of about 7° in 10° of latitude, but in Area III there was a steep slope of about 6° to 3° of latitude. East and west the profiles were roughly parallel.

Temperatures at the 100-meter level were 1° - 3° lower than at 50 meters. At the 200-meter level they were 1° lower than at 100 meters. The slopes at these levels were approximately the same as at 50 meters.

Specific gravities at all levels were around 2500 in the northeastern part of the area and 2600 in the southwest.

August

Five vessels were operating during this month. Most of them were close to the parallel of 45°N and a few were on the south side of 40°N in

the neighborhood of 175°E. Surface temperatures ranged from 16° to 21° between 45°N and 40°N giving a slope of 5° for 5° of latitude. The eastern and western profiles were roughly parallel. There was a warm zone of 25° in the vicinity of 38°N, and a cold zone with a temperature of 13° in the northwestern corner of the area. The zones of 17° - 19° water had moved northward 2° of latitude from their position of the previous month and were in the neighborhood of 44°N. This represents a shift of 1° to 2° of latitude northward over the previous year.

The temperatures at the 50-meter level were 5° - 6° lower than those at the surface, and those at 100 meters and 200 meters were each one degree lower. At each level the slope was 3° of temperature to 4° of latitude, and the east-west profiles were roughly parallel.

Specific gravity values in the surface waters were 2450 in the northwestern part of Area III and 2500 at the northern edge of Area II. Throughout the whole area the value of 2550 followed roughly along the parallel of 43°N. Across Areas II and III there was highly saline water of 2700 north and south of the parallel of 38°N. The 50-meter, 100-meter, and 200-meter levels all showed the same tendency toward higher chlorinities in the southern part of the area and lower values to the northeast.

September

During this month there were seven vessels in operation, all of them between 40° and 45°N. Surface water temperatures ranged from 14° to 21°, giving a slope of 7° of temperature in 5° of latitude. The profiles were roughly parallel east and west. The zones of 17° - 19° water showed a tendency to move somewhat southward in this month, and were located in the vicinity of 43°N. In the neighborhood of 45°N, where the water temperature had been 16° in the preceding month, temperatures of 14° or 15° appeared in places.

Temperatures at the 50-meter level were 5° - 6° below those at the surface and went down to 9° in the north and 15° in the southern part of the area. The temperature profiles were roughly parallel to the east and west on both sides of a complex formation in the vicinity of the 180th meridian.

Temperatures at the 100-meter level were 1° lower than those at the surface, and those at the 200-meter level were 2° lower than the 100-meter level.

At all levels there was a tendency for lower specific gravities to accompany lower temperatures, but in general the values were higher in the east and lower in the west.

First Ten Days of October

Six vessels were operating during this period, most of them between 40°N and 45°N with a few of them in the neighborhood of 39°N. The surface water temperatures ranged from 15° to 18° giving a slope of 3° for 7° of latitude, and the east-west profiles were roughly parallel. The zones of

17° - 19° water had moved southward about 3° of latitude to the vicinity of 40°N.

The 50-meter level had temperatures of from 2° to 5° lower than those at the surface, and those at the 100-meter level were 1° - 4° below those at 50 meters. At the 200-meter level the temperatures were 1° to 2° below those of the 100-meter level. At all levels the specific gravities were directly proportional to the temperatures with low chlorinities in the north and high values in the south, however, no chlorinities of more than 2600 were found.

In conclusion, a comparison of the surface temperature distribution during this year's operating period from May to October with the distribution shown for the same area on the North Pacific Oceanographic Charts published by the Navy Hydrographic Office shows a tendency toward roughly the same distribution, however, various localized differences due to conditions at the time are apparent. An examination of the vertical distribution of temperatures at the 50-meter and 100-meter levels indicates that the temperature difference between the surface and the 100-meter level gradually increases from May to September, but that from October on it decreases at a comparatively rapid rate. The rate of increase and decrease of the difference between the temperature at the 50-meter level and the 100-meter level was not very marked this year.

A grouping by areas of the cases in which albacore were taken and the cases in which no albacore were taken is shown in Table 7A "Cases in Which Albacore Were Taken" and B "Cases in Which No Albacore Were Taken".

(B) Water Temperatures and Catch Ratios

In order to aid the consideration of the level at which the albacore swim in the operating area of this investigation, the relationship between catch rates and the temperatures at the surface, 50 meters, and 100 meters has been shown in tables 8, 9, and 10. The catch rates used in these tables are the number of fish taken per 100 hooks fished, and the temperatures have been rounded off by discarding fractions below .5 (for example a temperature recorded as 15° means from 14.5° to 15.4°).

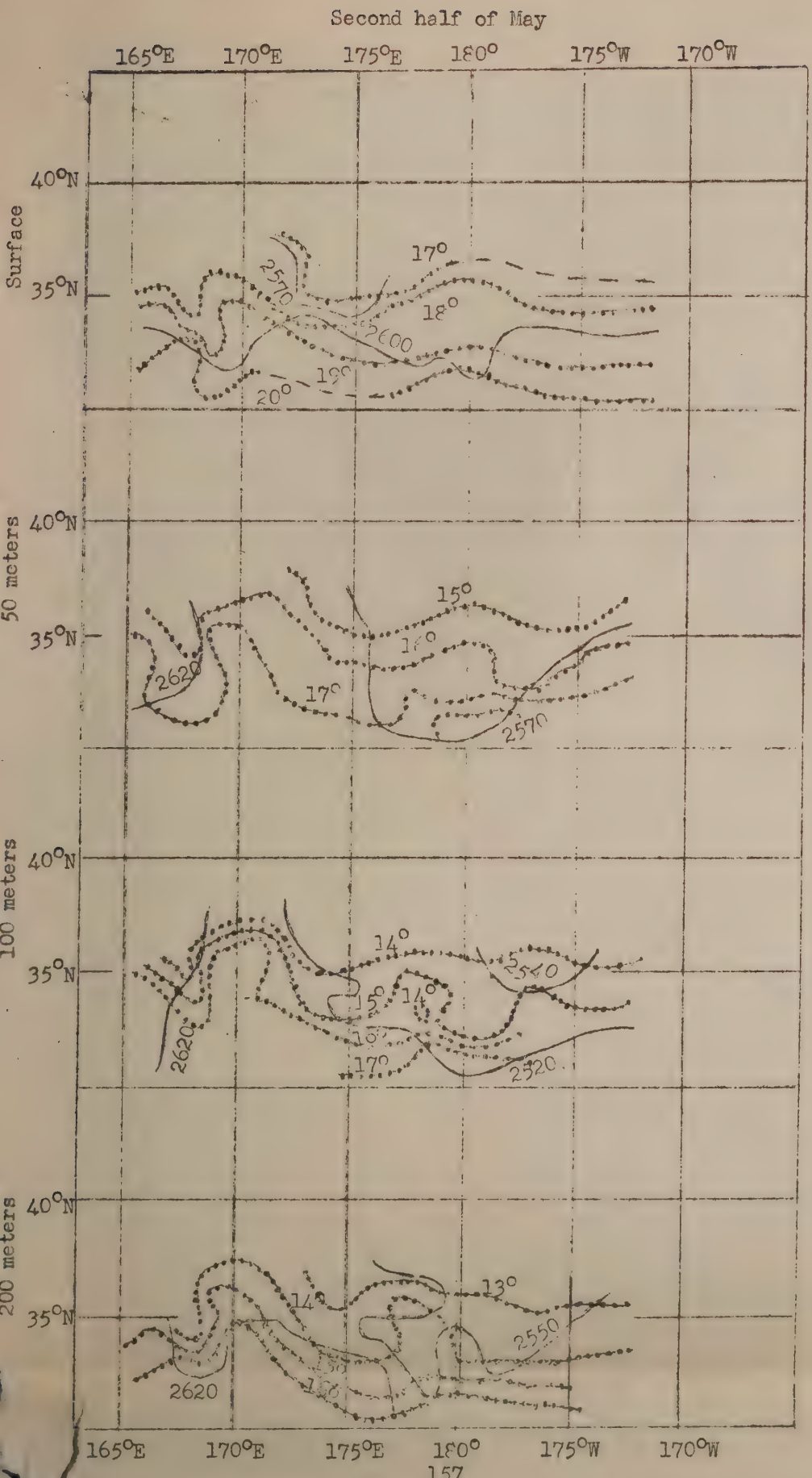
Figure 4 Charts of Monthly Isotherms and Isochlors

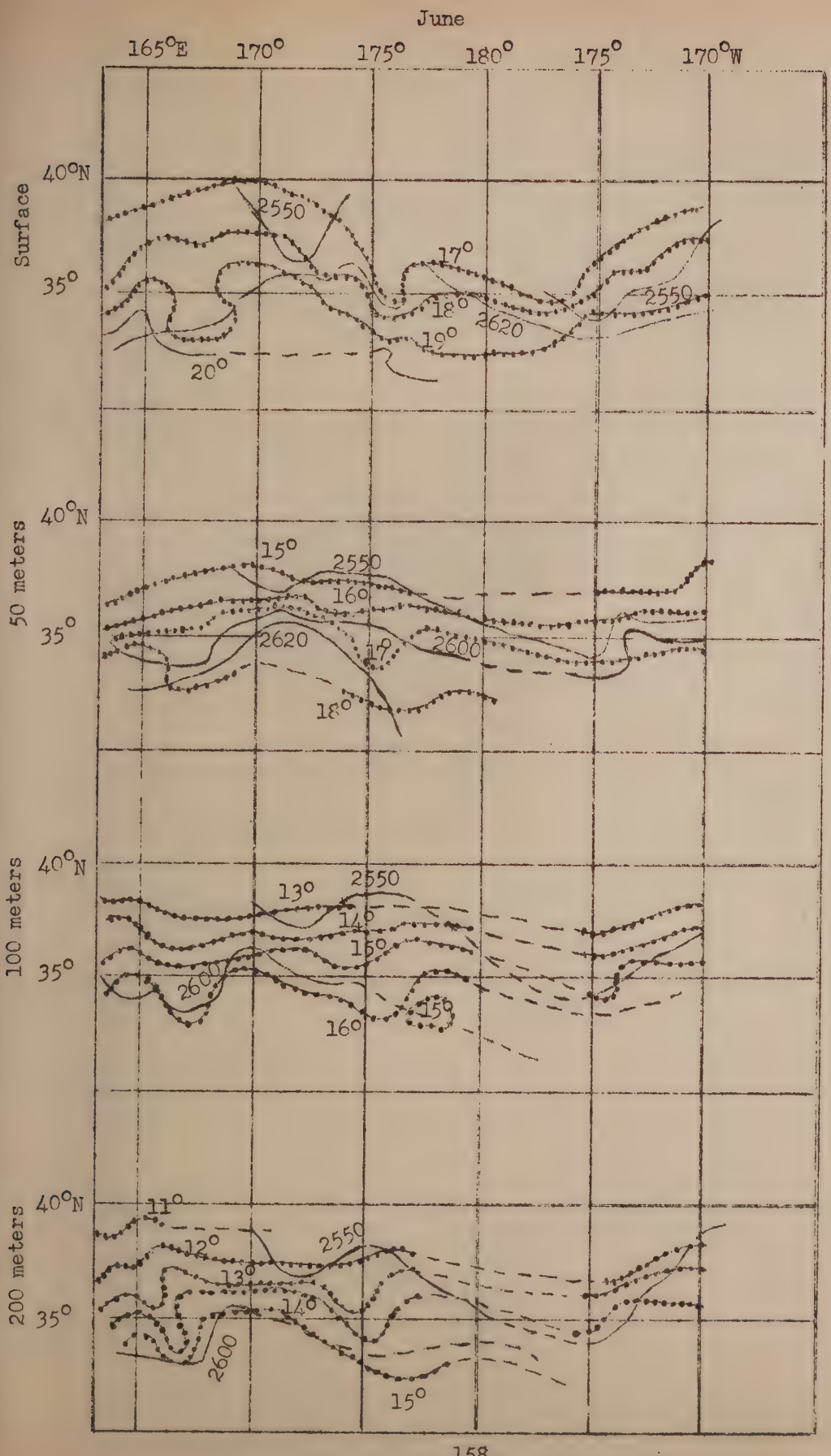
Dotted lines show presumed positions.

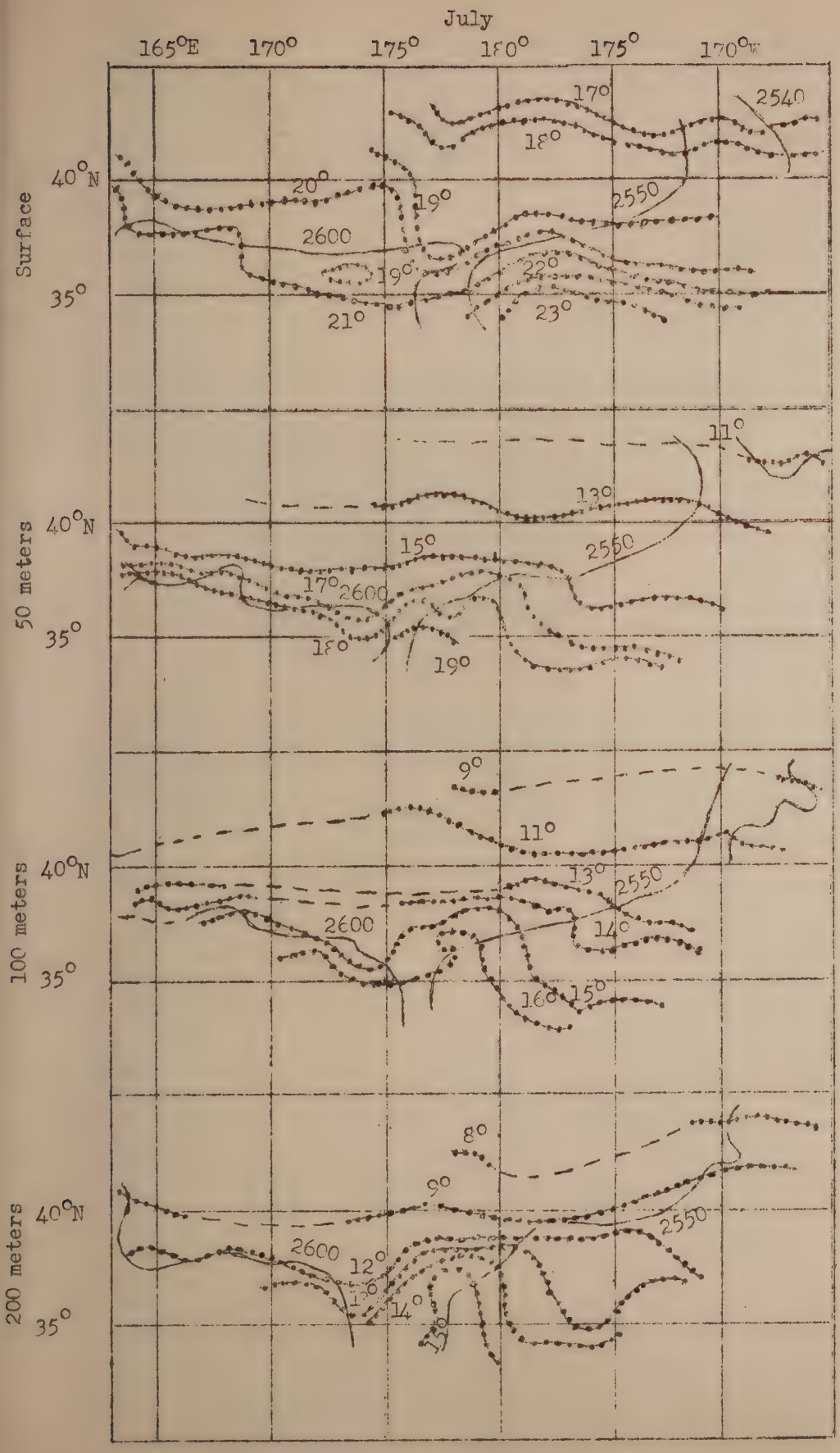
isotherms

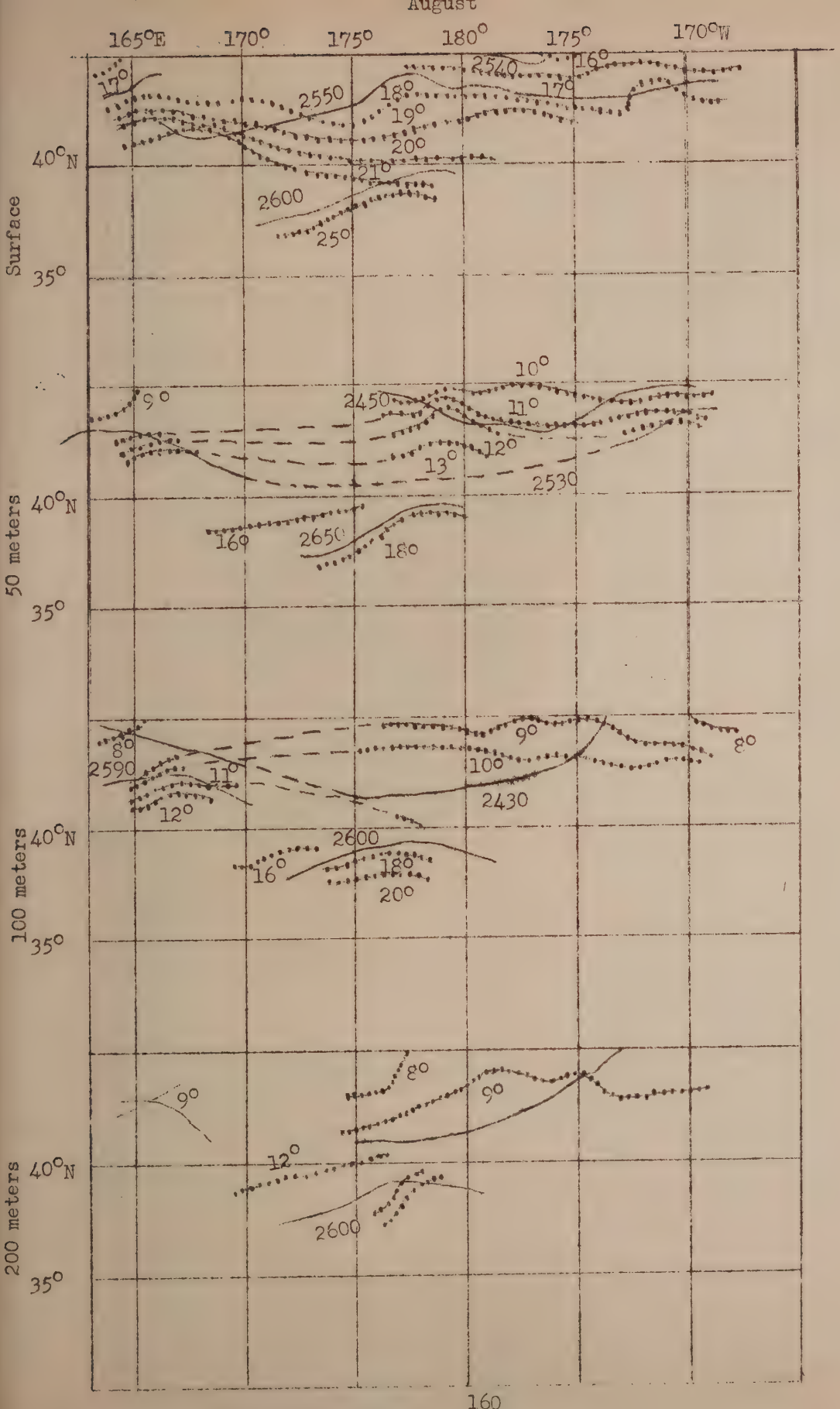
isochlors

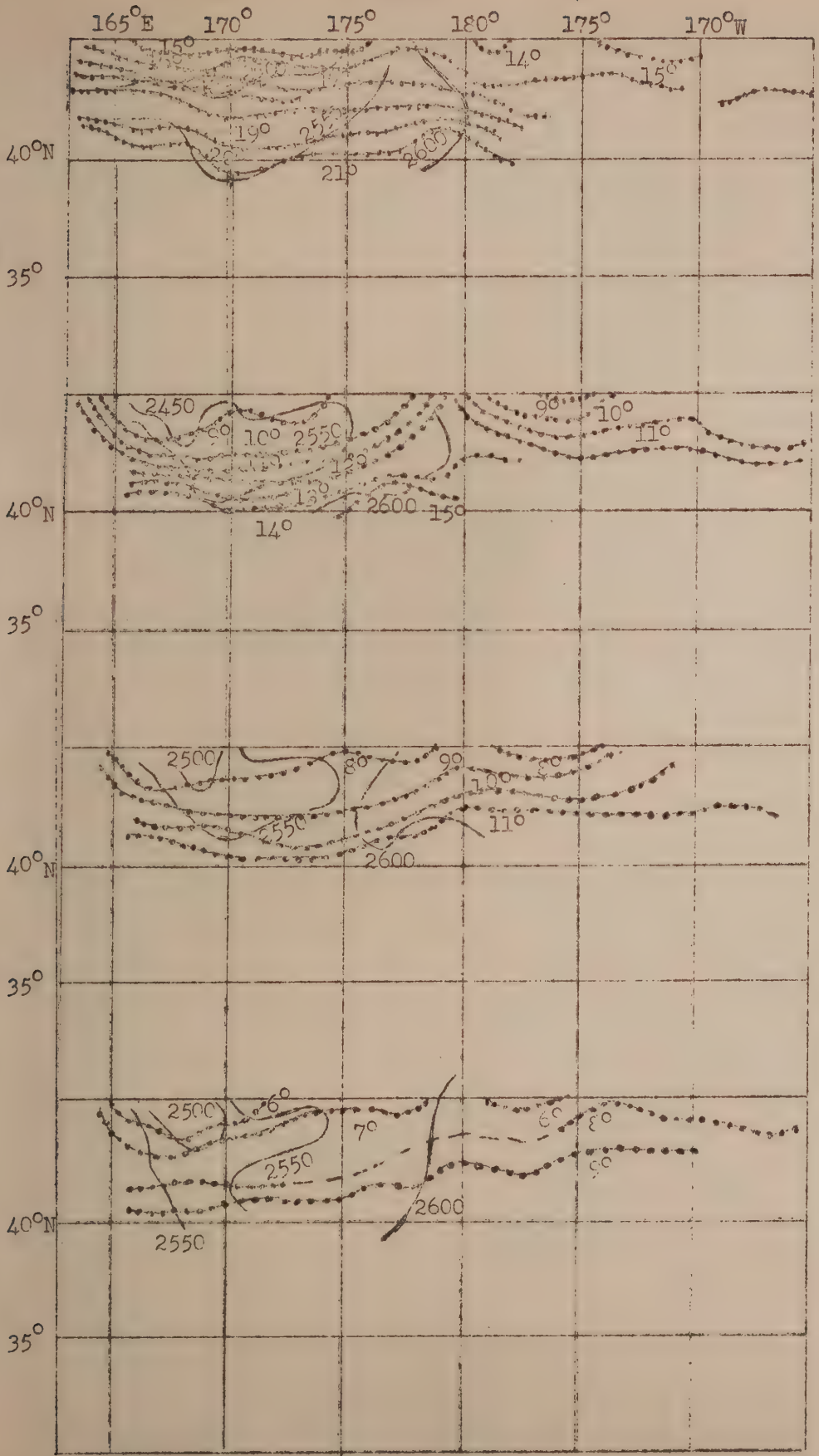
[TN: The figures on the graphs are in many cases almost illegible and the readings given in the translation must be regarded as guesses, especially in the case of some of the isochlors.]

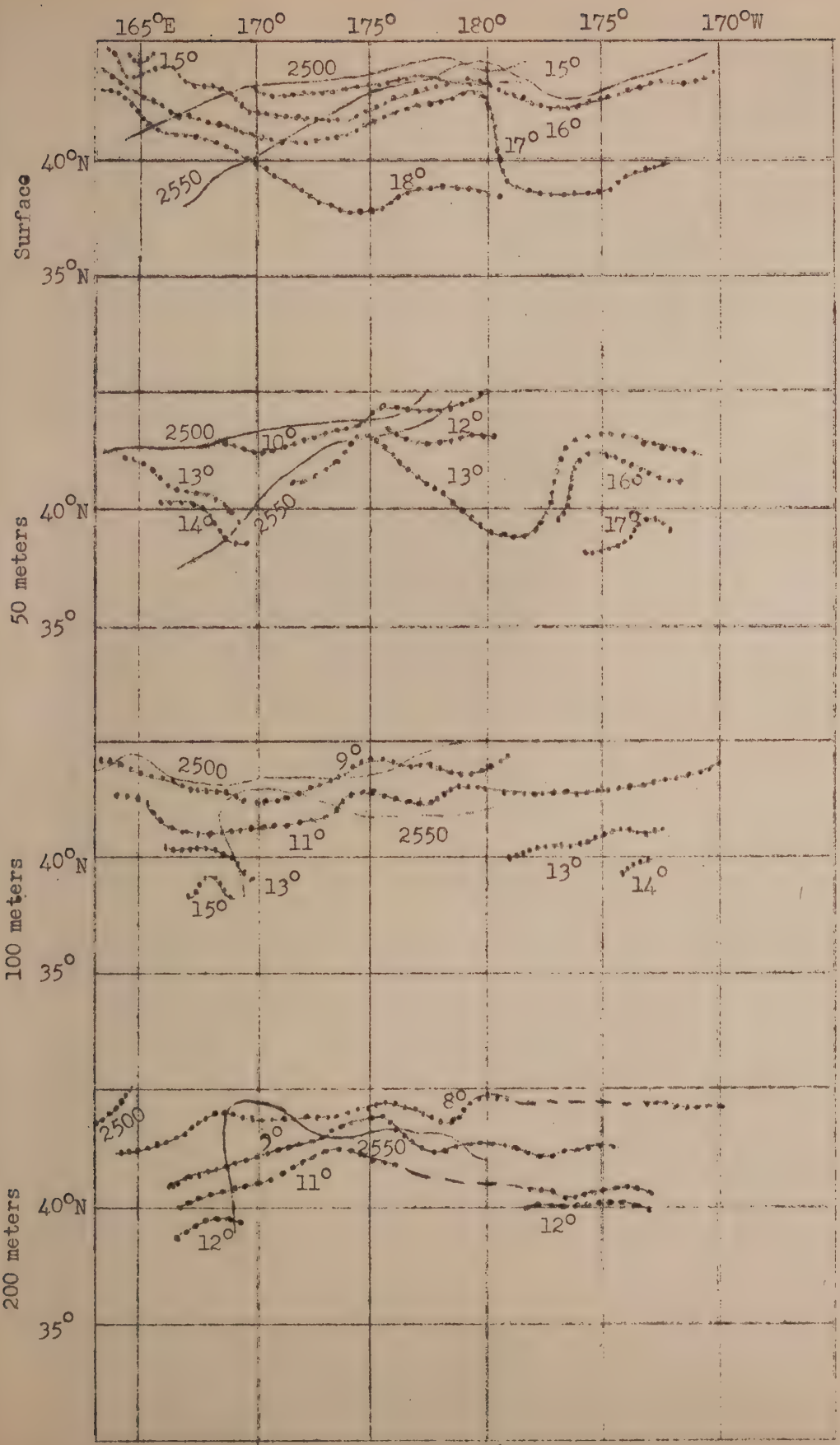

Second half of May
165°E
170°E
175°E
180°
175°W
170°W
40°N
35°N
Surface
17°
2570
18°
2600
19°
20°
50 meters
15°
16°
2620
17°
2570
100 meters
14°
2540
15°
14°
2620
16°
17°
2520
200 meters
14°
13°
2550
2620


June
165°E
170°
175°
180°
175°
170°W
Surface
40°N
35°
2550
17°
18°
2620
19°
20°
2550
50 meters
40°N
35°
15°
2550
16°
2620
17°
2600
18°
100 meters
40°N
35°
13°
2550
14°
15°
2600
16°
15°
200 meters
40°N
35°
11°
12°
13°
14°
2550
2600
15°


July
165°E
170°
175°
180°
175°
170°W
Surface
40°N
35°
17°
18°
2540
20°
19°
2550
2600
19°
22°
21°
23°
50 meters
40°N
35°
11°
13°
15°
2550
17°
2600
18°
19°
100 meters
40°N
35°
9°
11°
13°
2550
2600
14°
16°
15°
200 meters
40°N
35°
8°
9°
2550
2600
12°
13°
14°
15°

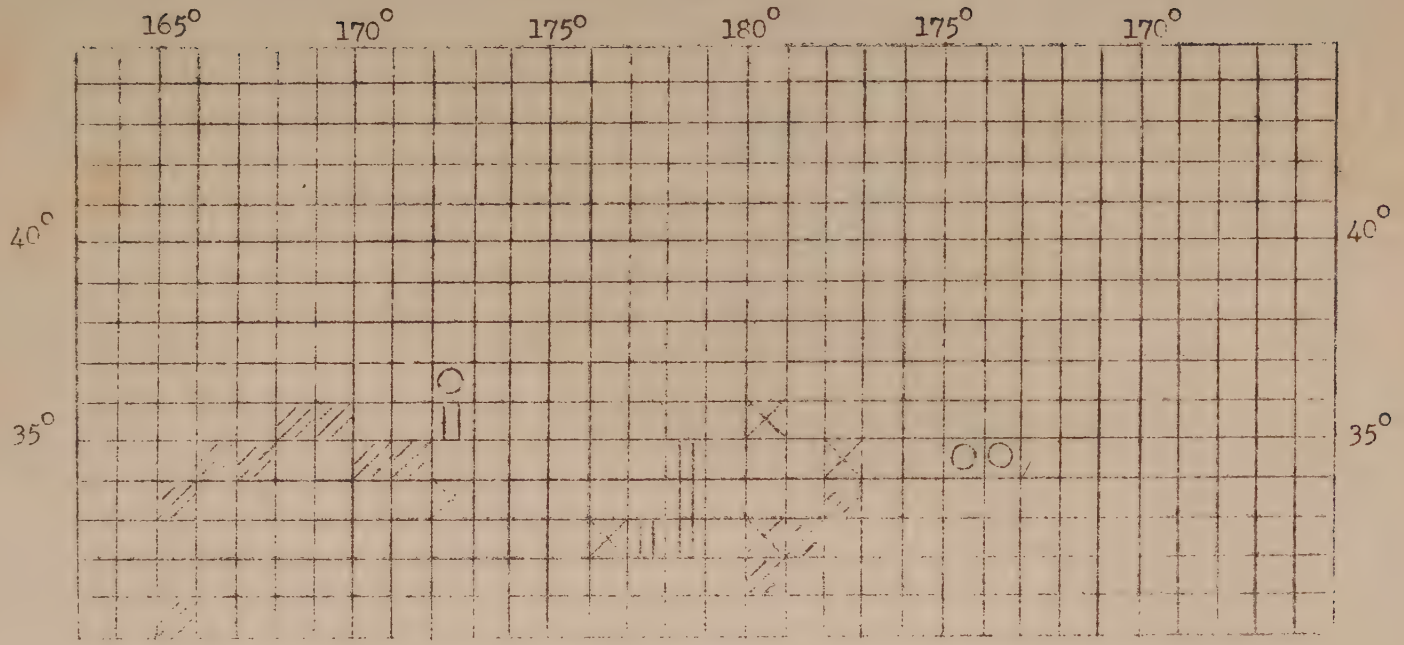

August
165°E
170°
175°
180°
175°
170°W
Surface
40°N
35°
17°
2550
18°
19°
20°
21°
2600
25°
2540
16°
17°
50 meters
9°
2450
10°
11°
12°
13°
2530
16°
2650
18°
100 meters
8°
2590
11°
12°
9°
10°
2430
8°
2600
16°
18°
20°
200 meters
9°
8°
9°
12°
2600


165°E
170°
175°
180°
175°
170°W
40°N
35°
15°
14°
15°
19°
25°
21°
2600
2450
9°
10°
11°
2550
13°
14°
2600
15°
2500
8°
9°
10°
11°
2550
2600
6°
7°
2500
2550
2600
2550


165°E
170°
175°
180°
175°
170°W
Surface
40°N
35°N
15°
2500
15°
17°
16°
2550
18°
50 meters
40°N
35°
2500
10°
12°
13°
13°
16°
14°
2550
17°
100 meters
40°N
35°
2500
9°
11°
2550
13°
15°
13°
14°
200 meters
40°N
35°
2500
8°
3°
2550
11°
12°
12°

Graph of Albacore Catch Density

May



catch rate of 10.0 or more

catch rate over 5.0 but less than 10.0

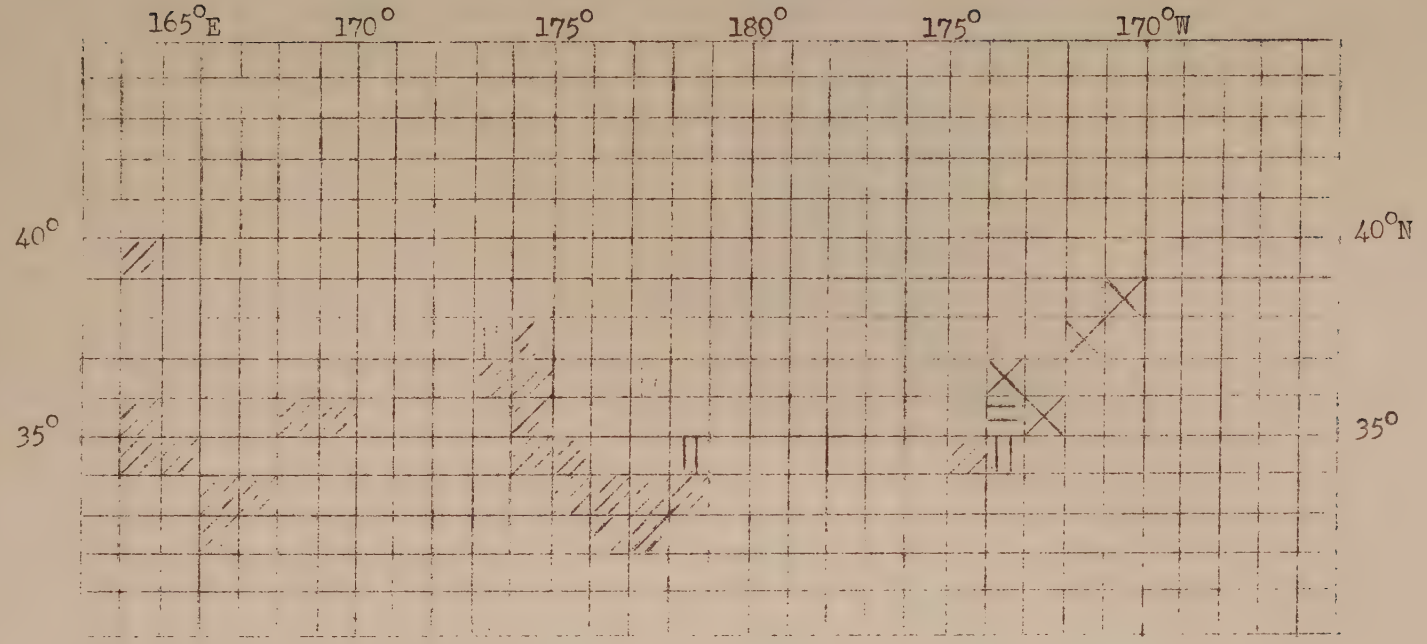
catch rate over 1.0 but less than 5.0

catch rate less than 1.0

no albacore catch

Graph of Albacore Catch Density

June



catch rate of 10.0 or more

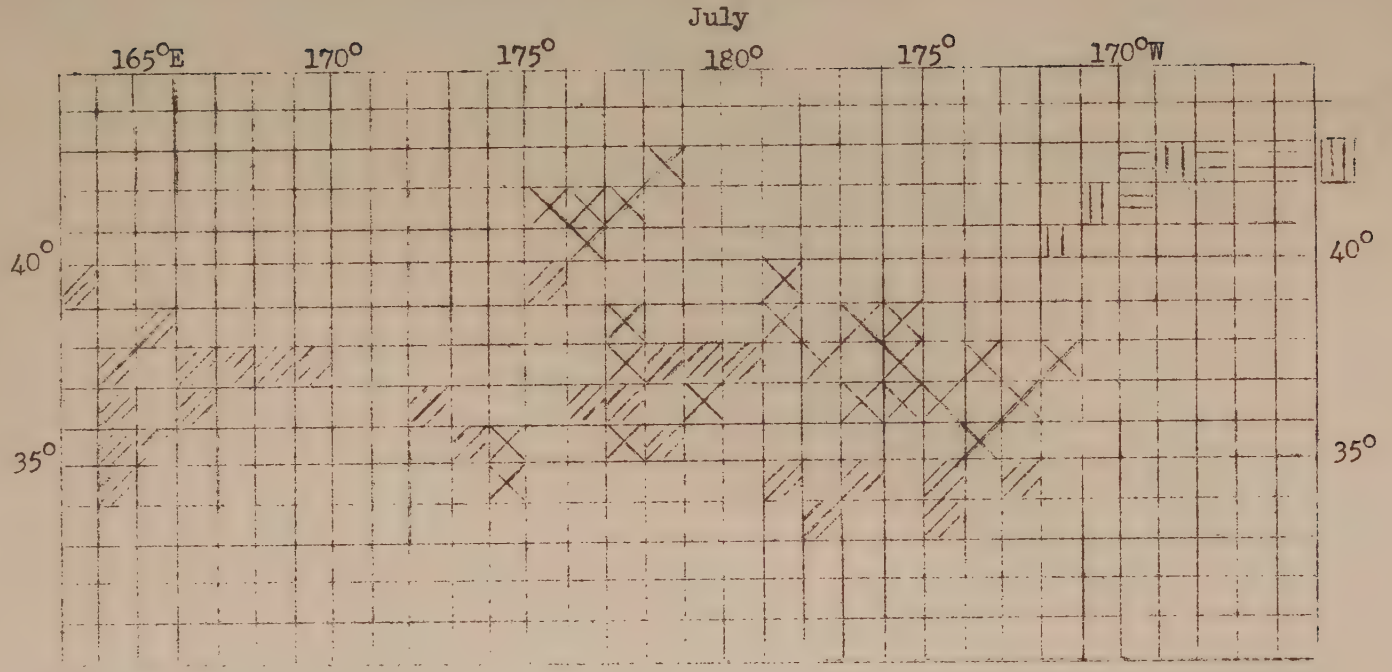
catch rate over 5.0 but less than 10.0

catch rate over 1.0 but less than 5.0

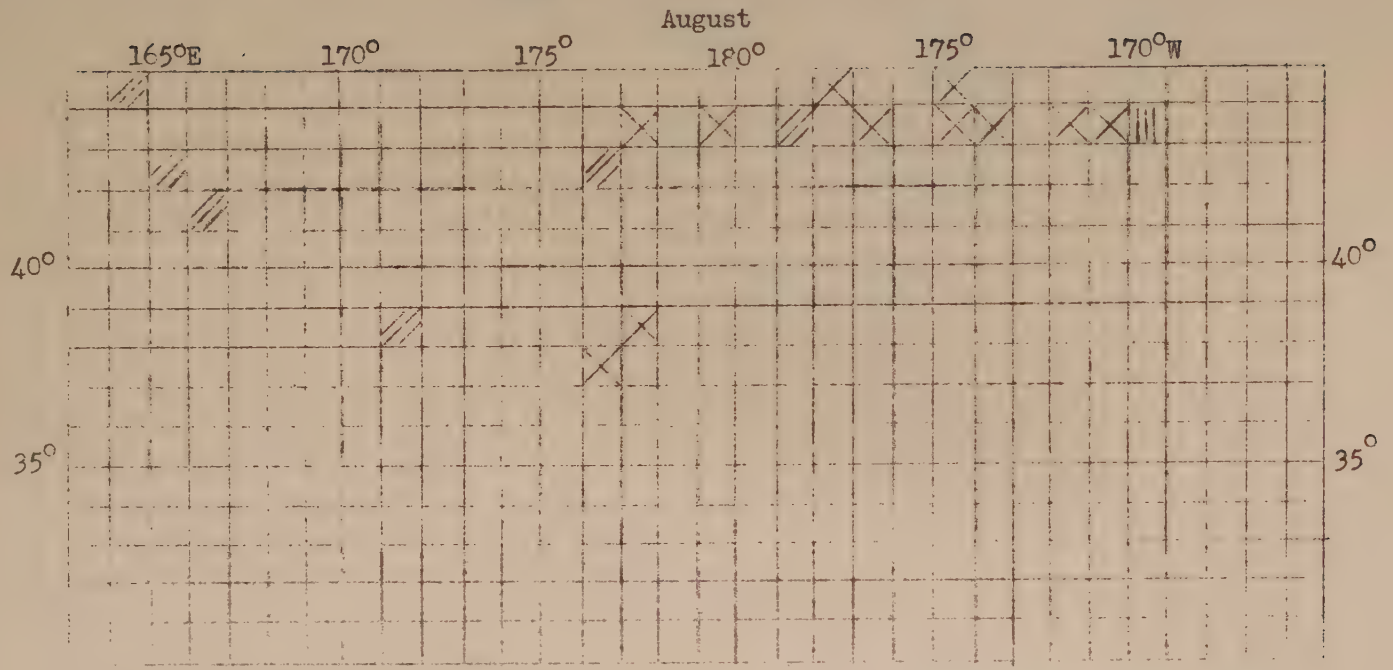
catch rate less than 1.0

no albacore catch

Graph of Albacore Catch Density

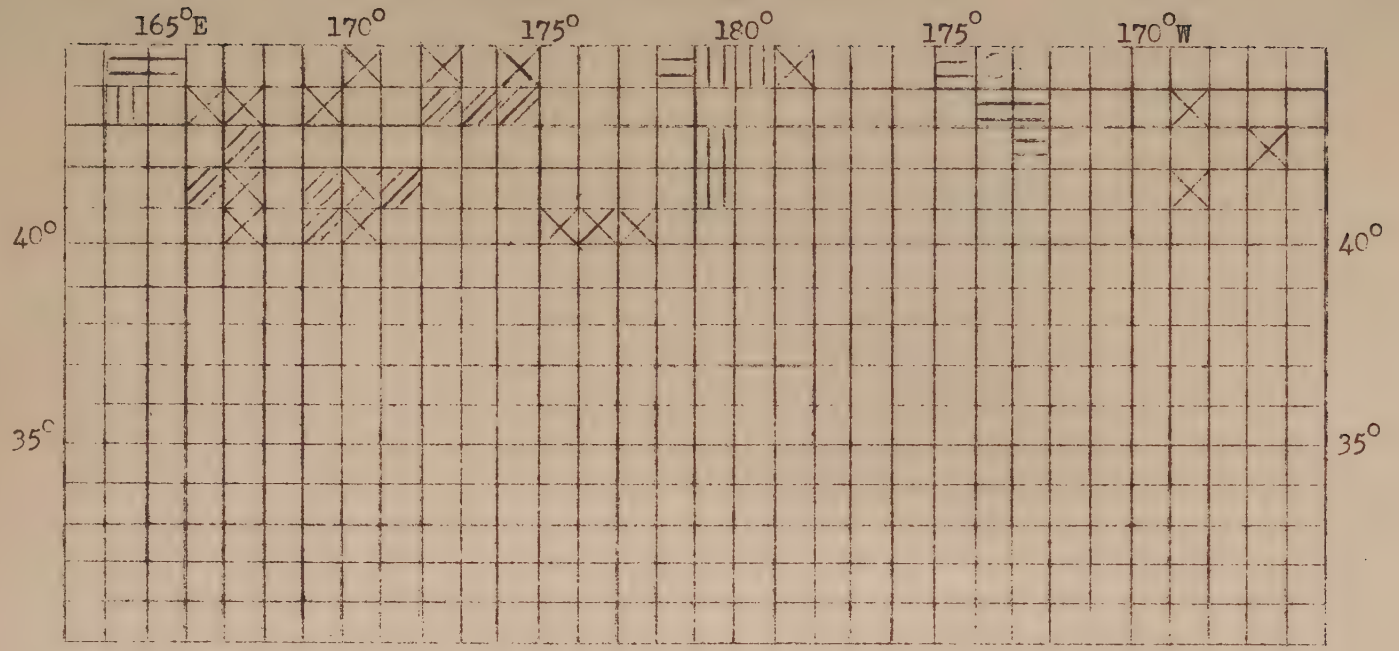


Graph of Albacore Catch Density



Graph of Albacore Catch Density

September



catch rate of 10.0 or more

catch rate over 5.0 but less than 10.0

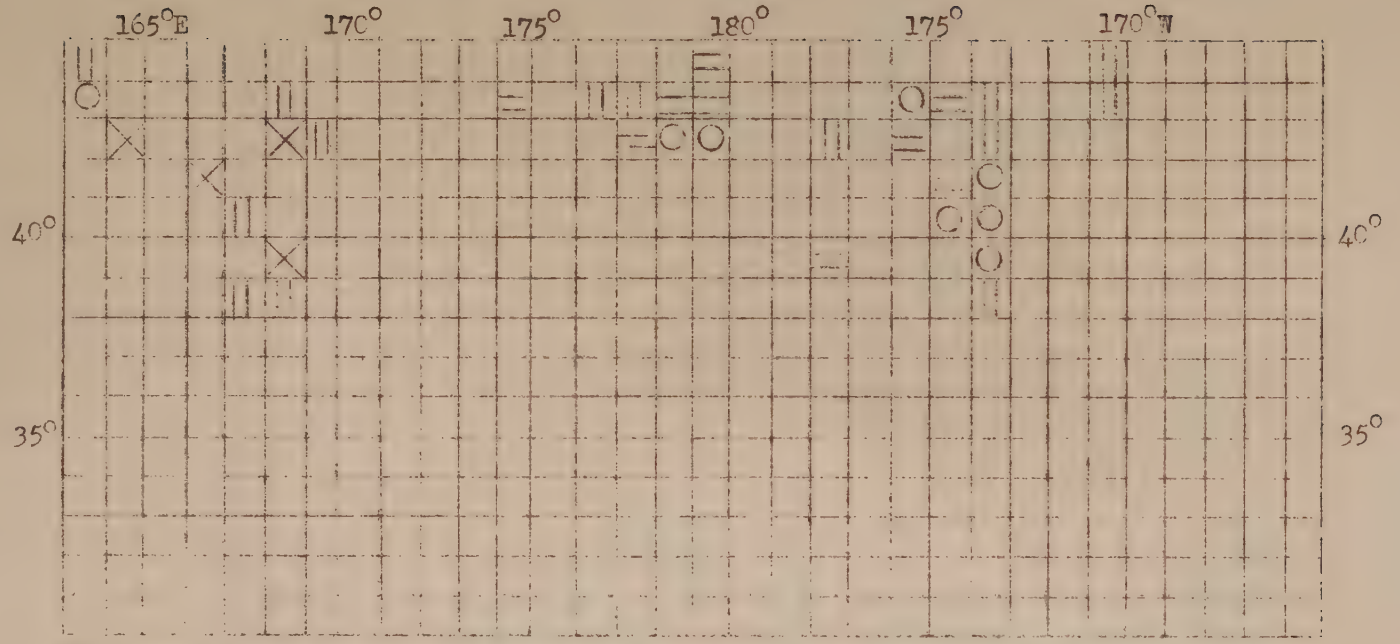
catch rate over 1.0 but less than 5.0

catch rate less than 1.0

no albacore catch

Graph of Albacore Catch Density

October



catch rate of 10.0 or more

catch rate over 5.0 but less than 10.0

catch rate over 1.0 but less than 5.0

catch rate less than 1.0

no albacore catch

Table 7 Relationship of the Albacore Catch and the Slope of the Vertical Distribution of Water Temperatures at Each Level (Surface, 50 Meters, 100 Meters) by Month and Area

A. Cases in Which Albacore Were Taken

Average Temperature at Each Level (°C)

Level	Surface (A)			50 Meters (B)			100 Meters (C)		
Month	I	II	III	I	II	III	I	II	III
5	18.0	18.5	17.3	16.1	15.9	16.1	14.7	15.1	15.1
6	18.1	18.1	16.4	16.2	16.9	15.5	14.7	16.0	12.1
7	18.9	19.1	18.6	13.3	14.6	16.9	11.8	12.9	15.1
8	17.7	20.1	20.7	11.0	13.9	13.5	9.4	12.2	10.8
9	16.9	18.3	18.8	10,7	13.4	11.6	9.3	10.8	9.2
10	15.9	15.9	17.9	14.9	12.9	14.8	12,5	10.4	10.7

Average Difference in Temperature Between Levels (°C)

Level	A -- B			B -- C			A -- C		
Month	I	II	III	I	II	III	I	II	III
5	1.9	2.6	1.2	1.4	0.8	1.0	3.3	3.4	2,2
6	1.9	1.2	0.9	1.5	0.9	3.4	3.4	2.1	4.3
7	5.6	4.5	1.7	1.5	1.7	1.8	7.1	6.2	3.5
8	6.7	6.2	7.2	1.6	1.7	2.7	8.3	7.9	9.9
9	6.2	4.9	7.2	1.4	2.6	2.4	7.6	7.5	9.6
10	1.0	3.0	3.1	2.4	2.5	4.1	3.4	5.5	7.2

Table 7B Relationship of the Albacore Catch and the Slope of the Vertical Distribution of Water Temperatures at Each Level (Surface, 50 Meters, 100 Meters) by Month and Area.

B. Cases in Which No Albacore Were Taken

Month	Average Temperature at Each Level (°C)								
	Surface (A)			50 Meters (B)			100 Meters (C)		
	I	II	III	I	II	III	I	II	III
5	---	19.6	18.5	---	17.3	16.7	---	16.1	15.7
6	---	19.2	18.7	---	16.9	17.3	---	15.4	16.1
7	22.8	22.7	20.8	17.3	18.7	17.4	15.4	16.3	15.2
8	---	17.5	19.6	---	11.3	13.4	---	9.7	11.7
9	---	20.7	18.9	---	14.6	12.2	---	11.5	9.8
10	---	---	---	---	---	---	---	---	---

Month	Average Difference in Temperature Between Levels (°C)								
	A -- B			B -- C			A -- C		
	I	II	III	I	II	III	I	II	III
5	---	2.3	1.8	---	1.2	1.0	---	3.5	2.8
6	---	2.3	1.4	---	1.5	1.2	---	3.8	2.6
7	5.5	4.0	3.4	1.9	2.4	2.2	7.4	6.4	5.6
8	---	4.1	6.2	---	1.6	1.7	---	7.8	7.9
9	---	8.5	6.7	---	3.1	2.4	---	9.2	9.1
10	---	---	---	---	---	---	---	---	---

Table 8 Comparison of Albacore Catch Rates and Surface Temperatures

Temperature	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	
Month															
5	---	---	---	9.23	5.87	2.94	1.40	---	---	---	---	---	---	---	-
6	---	---	0.10	---	4.89	3.75	---	---	---	---	---	---	---	---	-
7	---	---	1.83	4.01	1.80	0.91	0.43	0.18	---	---	---	---	---	---	-
8	---	---	---	0.20	0.53	---	---	0.10	---	---	---	0.40	0.20	---	-
9	0.10	4.35	6.65	3.37	0.40	0.30	0.17	0.37	---	---	---	---	---	---	-
10	---	5.56	5.03	9.84	4.28	1.30	1.20	---	---	---	---	---	---	---	-

Table 9 Comparison of Albacore Catch Rates and Temperatures at the 50-meter Lev

Temperature	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	
Month															
5	---	---	---	---	---	---	---	---	1.20	7.26	4.62	1.40	---	---	-
6	---	---	---	---	---	---	---	---	---	5.63	3.67	0.20	---	---	-
7	---	---	---	4.50	2.55	4.62	0.68	0.47	0.51	0.28	0.23	0.10	---	---	-
8	---	---	---	0.20	0.49	0.45	0.10	0.10	---	---	---	---	---	---	-
9	---	2.67	5.21	3.91	2.56	4.53	0.10	0.30	1.70	0.37	0.50	---	---	0.20	-
10	2.00	---	6.15	4.92	5.00	2.58	9.16	4.33	5.95	12.11	9.36	5.10	0.96	1.70	-

Table 10 Comparison of Albacore Catch Rates and Temperatures at the 100-meter Leve

Temperature	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°	18°	
Month															
5	---	---	---	---	---	---	---	---	---	26.20	4.91	6.72	0.55	---	-
6	---	---	---	---	---	---	---	0.10	0.90	0.53	5.28	5.28	---	---	-
7	---	---	---	---	2.50	3.69	2.88	0.23	0.61	0.39	0.17	0.27	---	---	-
8	---	---	---	---	0.47	0.24	0.10	0.70	---	---	---	---	---	---	0.
9	---	1.68	0.80	4.07	5.84	2.17	2.00	0.30	---	---	---	---	---	---	-
10	4.30	3.35	---	10.23	5.15	5.30	6.97	7.50	2.33	6.48	1.60	17.3	---	---	-

(II) Table of Sums Designated to be Paid as Subsidies for Albacore Fishing Grounds Development

Vessel	Prefecture	Item	Amount (¥)	Operating Period
Shiratori Maru	Aichi	Development grant Supervision grant Total	25,000.00 1,000.00 26,000.00	May 1 to Sept. 30 5 months
Miyagi Maru	Miyagi	Development grant Supervision grant Total	23,300.00 1,000.00 24,300.00	May 1 to Oct. 31 of which 5 months
Aomori Maru	Aomori	Development grant Supervision grant Total	20,200.00 900.00 21,100.00	May 1 to Oct. 31 of which 5 months
Fusa Maru	Chiba	Development grant Supervision grant Total	18,850.00 450.00 19,300.00	May 1 to Oct. 31 of which 5 months (150 days)
Akita Maru	Akita	Development grant Supervision grant Total	16,000.00 1,000.00 17,000.00	May 1 to Sept. 30 5 months
Iwate Maru	Iwate	Development grant Supervision grant Total	16,320.00 880.00 17,200.00	June 1 to Oct. 31 5 months
Sagami Maru	Kanagawa	Development grant Supervision grant Total	15,110.00 390.00 15,500.00	May 1 to Oct. 31 of which 5 months
Kamui Maru	Mie	Development grant Supervision grant Total	15,460.00 840.00 16,300.00	June 1 to Oct. 28 of which 150 days
Musashi Maru	Tokyo	Development grant Supervision grant Total	13,990.00 810.00 14,800.00	May 1 to Sept. 30 5 months

(Appended for Reference)

(I) Budget of Albacore Fishing Ground Subsidies

Subsidy funds for albacore fishing ground development	¥ 171,500
(a) Grants for development	160,000
(b) Grants for supervision	11,500

(II) Table of sums designated to be paid as subsidies for albacore fishing ground development

An Investigation of Albacore

Purpose

To clarify the habits of albacore by conducting a biological study of albacore caught by the Fuji Maru. [TN: research vessel of Shizuoka Pref.]

Results

In order to determine the food of albacore, more than 70 fish were examined. Almost all of these albacore contained sardines, ami [TN: Mysis], squid, octopus, and other common food. Fish which had ingested fish bones, scales, and pieces of radishes and carrots (possibly thrown overboard from fishing vessels) were also found.

Judging from the condition of the gonads of albacore in January, June, and from August to September, it may be assumed that albacore spawn around November.

Note: Fishing grounds covered by the Fuji Maru are as follows:

Data	Operating period	Position		Remarks
		E. Long.	N. Lat.	
Jan. tuna	Jan. 5-21	178°-179°	28°-30°	
June tuna	June 15-19	164°-174°	28°-36°	
Aug.-Sept. tuna	Aug. 24-Sept. 13	165°-178°	39°-43°	

Although Mr. Hasegawa [TN: biologist with Shizuoka Prefecture Fisheries Experiment Station] believes that the spawning grounds of albacore are possibly located near the Midway Islands in waters from 26°-27° C., this has not been yet confirmed. It is thought that the female releases over 300,000 eggs at a single spawning and that these eggs are pelagic.

Fish weighing over 1.4 kg. have been caught from August to September. As with fish which are 9-10 months old, these albacore have a pectoral fin length / body length ratio of 0.246. Other mature individuals weighing from 15-18.75 kg. have a pectoral fin length / body length ratio of about 0.421 with a variation of 0.166. Therefore, it may be concluded that the pectoral fins of juvenile albacore are short and that these fins lengthen with growth.

No significant differences were found in ratios of head body / length, pectoral fin length / body length, and body weight / body length of males and females (females have a body weight / body length ratio approximately 0.015-0.018 % greater than males, but this difference is difficult to determine by observation). Consequently, it is hard to distinguish between male and female albacore.

The following tables represent body length, body weight, etc. of albacore:

Table 1

Season	Total Length	Body Length	Depth	Head Length	Length of pectoral fin	Weight	Remarks
	(bu)	(bu)	(bu)	(bu)	(bu)	(momme)	
June	382	251	71	80	99	3.210	female
"	309	270	78	89	116	4.080	"
"	304	255	70	79	105	3.413	"
"	295	262	74-	79	107	3.253	"
"	281	239	67	76	102	2.613	"
"	255	247	71	77	108	3.013	"
"	315	261	75	84	103	3.547	male
"	284	243	67	75	105	2.827	"
"	275	234	66	75	101	2.613	"
"	246	208	58	67	81	1.680	"
Average	295	247	70	78.1	103	3.016	
Aug.- Sept.	328	283	80	87	120	4.400	female
"	317	269	76	83	117	3.890	"
"	312	266	77	82	110	3.520	"
"	312	264	74	82	113	3.450	"
"	295	255	68	78	93	2.890	"
"	319	275	78	85	126	3.840	male
"	314	266	74	82	103	3.500	"
"	294	252	71	78	109	2.810	"
"	285	243	72	78	100	2.840	"
"	255	219	60	67	81	1.850	"
Average	303	259	73	80	107	3.299	

[TN: 1 bu = .12 inch; 1 momme = .1325 ounce.]

Table 2

Data	Body wgt. / Body length	Pectoral fin / Body length	Head lgth. / Body length	Body wgt. (momme)	Body lgth. (bu)	Remarks
June						
female	12.6	0.419	0.316	3.247	256	Average of 6 fish
male	11.1	0.411	0.319	3.666	238	Average of 4 fish
Aug.-Sept.						
female	13.5	0.426	0.308	3.630	267	Avg. 5 fish
male	11.7	0.412	0.309	2.968	251	Avg. 5 fish
Aug.-Sept. smallest fish	3.0	0.446	0.306	.400	134	Sex not known